LIBRARY

AUG 1989

Pacific Islands Fisheries Service
2570 Dole Street
Honolulu, Hawaii

AQUATIC AND WILDLIFE RESOURCES

DEPARTMENT OF AGRICULTURE

OCTOBER 1, 1986 - SEPTEMBER 30, 1987
FY 1987

Guam
Aquatic
and
Wildlife
Resources
Annual
Report
FY'87

ANNUAL REPORT
FISCAL YEAR 1987

GUAM
AQUATIC & WILDLIFE RESOURCES DIVISION
Harry T. Kami, Chief

DEPARTMENT OF AGRICULTURE
Joaquin N. Naputi, Director (Acting)

Edited by:
Gretchen R. Grimm
Lillian L. Mariano

PERIOD COVERED:
September 30, 1986 to October 1, 1987

AQUATIC & WILDLIFE RESOURCES STAFF

The following persons were on the staff of the Aquatic and Wildlife Resources Division sometime during the reporting period (October 1 1986 to September 30, 1987).

Harry T. Kami, Chief
Robert D. Anderson, Assistant Chief

Sport Fisheries

Gretchen R. Grimm, Fisheries Biologist III
Robert F. Myers, Fisheries Biologist III
Gerald W. Davis, Fisheries Biologist II
Oscar T. Mata, Biological Aid

Aquaculture

Wayne Kruckenberg, Fishery Biologist II
Robert J. Cruz, Biological Aid

Wildlife

Robert E. Beck, Wildlife Biologist III
Paul J. Conry, Wildlife Biologist III
Gary J. Wiles, Wildlife Biolgist III
Jesse Guerrero, Biological Aid
Herman Q. Muna, Biological Aid

Law Enforcement

Johnny S. Villagomez, Conservatioin Officer II
Wayne W. Bigler, Conservation Officer I
Leonard Z. Iriarte, Conservation Officer I
Michael A. Reyes, Conservation Officer I
Johnny M. Taitague, Conservation Officer I
David C. Torres, Conservation Officer I
Herman R. Quichocho, Conservation Officer I
Danny D. Wolford, Conservation Officer I

Clerical

Janet C. Blas, Word Processing Secretary II
June Elibosang, Administrative Assistant
Nancy C. Mafnas, Secretary Typist I
Annie S. Carriaga, Clerk Typist

ACKNOWLEDGEMENTS

The Aquatic & Wildlife Resources Division, Department of Agriculture, wishes to acknowledge the following persons and organizations for their assistance in our work:

The members of the Guam Fishing and Boating Association, the Marianas Fishing Derby Committee and the manager of the Guam Fisherman's Coop for allowing fishery biologists to examine their fish.

All fisherman who cooperated with fishery data collection.

All farmers engaged in aquaculture who cooperated by providing information and harvest data.

All hunters who have cooperated with wildlife data collection by filling out and returning hunter questionnaires.

The Base Commanders of the U.S. Naval Magazine, Naval Facility, Naval Station, Naval Communication Station and Andersen Air Force Base.

The Security Officers and their staffs at the U.S. Naval Magazine, Naval Station, Naval Communication Station and Andersen Air Force Base.

The Commander of the Marianas Section, U.S. Coast Guard.

The members of both print and electronic media for their assistance with our conservation education program.

The Cushing Zoo for cooperation with the Division by caring for injured wildlife.

The personnel of the Naval Oceanographic Command Detachment, U.S. Naval Air Station, Guam, for providing weather data.

Table of Contents

			Page
Section 1	Coordination and Administration Project FW-2R-24 (Federal Aid in Fish and Wildlife Restoration Acts)		1
	Job C-1	Coordination of Guam's Fish and Wildlife Programs	2
	Job C-2	Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources	4
	Job C-3	Public Information and Education of Guam's Fish and Wildlife Restoration and Endangered Species Programs	14
Section II	Guam Fisheries Investigations - Project FW-2R-24. (Federal Aid in Sport Fish Restoration Act)		15
	Job F-1-1	Offshore Fisheries Survey	16
		Guam International Fishing Derby	30
	Job F-1-2	Inshore Fisheries Survey	35
	Job F-1-3	Fisheries Data Processing	44
	Job F-1-8	Studies of Recreationally Important Reef Fish	47
	Job F-1-11	Biomass and Stock Assessment	48
Section III	Guam Fisheries Development - Project F-2-D (Federal Aid in Sport Fish Restoration Act)		50
	Job F-2-D-6	Construction of Fish Aggregating Devices	51
	Job F-2-D-7	Development of Small Boat Launching Facilities	56
Section IV	Aquaculture (Public Law 88-309, Matching Funds)		57
	Development of Tropical Polyculture Fish Farming		58
Section V	Guam Wildlife Investigation Project FW-2R-24 (Federal Aid in Wildlife Restoration Act)		65
	Job W-1-1-1	Determination of Current Population Size and Distribution of Guam Deer	66
	Job W-1-1-3	Determination of Diet Quality of Guam Deer	74
	Job W-1-2-1	Preparation of Status Report on Wild Pigs	76
	Job W-1-2-2	Population Size and Distribution of Wild Pigs on Guam	77
	Job W-1-2-4	Wild Pig Biology and Natural History	82
	Job W-2-1-1	Preparation of a Status Report on Philippine Turtle Doves	83
	Job W-2-1-2	Population Numbers and Distribution of Philippine Turtle Doves	84
	Job W-2-2-1	Preparation of a Status Report on Black Francolin	89
	Job W-2-2-2	Population Size and Distribution of Black Francolin on Guam	90
	Job W-4-1-3	Survey and Inventory of Native Birds on Guam and Northern Mariana Islands	96

	Job W-5-1-2	The Current Status, Distribution and Natural History for Marianas Fruit Bats	97
Section VI		Guam Endangered Species Investigation Project E-1-2 Section 6 - Endangered Species Act of 1973	98
	Job 4-1	Captive Breeding Endangered Native Birds	99
	Job 4-2	Development of an Experimental Population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands	102
	Job 5-1	Native Bird Status Surveys and Natural History	106
	Job 5-2	Habitat Protection and Management for the Native Birds of Guam	119
	Job 6-1	Law Enforcement and Legal Protection for the Marianas Fruit Bat	123
	Job 6-2	Natural History, Biology, and Habitat Protection for the Marianas Fruit Bat	124
	Job 7-1	Biology of the Brown Tree Snake	136
	Job 7-2	Movements, Home Range and Activity Patterns of the Brown Tree Snake	139
	Job 7-3	Development and Testing of Control Methods for the Brown Tree Snake	143
	Job 8-1	Public Awareness and Conservation Education	144
Section VII		Law Enforcement (Funded by Government of Guam)	145
		Law Enforcement	146

COORDINATION AND ADMINISTRATION
PROJECT FW-2R-24
Federal Aid in Fish and Wildlife Restoration Acts

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: C-1
JOB NO.: 1

JOB TITLE: Coordination of Guam's Fish and Wildlife Programs

PERIOD COVERED: October 1, 1986 to September 30, 1987

OBJECTIVES

To plan, coordinate, supervise, and administer all fish and wildlife restoration programs.

PROCEDURES

1. Supervise the planning and documentation of the Fish and Wildlife programs.
2. Administer all fiscal and budgetary matters and coordinate with the Central Accounting and Budget Office.
3. Administer all personnel matters including recruitment of off-island staff.
4. Represent the Division and Department of Agriculture in all matters pertaining to Fish and Wildlife Resources.

RESULTS

The Division Chief and his staff were involved in preparing required documentation for the DJ-PR funded Guam Fish and Wildlife Investigation Program (FW-2R) and the Guam Endangered Species Program (E-1) funded under a Section 6 Cooperative Agreement. Documentation included various Project Agreement and AFA amendments and the Project Agreement for Segment 25.

Fiscal and budgetary activities included monthly preparation and submission of reimbursement vouchers for our various Federal Aid programs and coordination with the Government Accounting and Budget Offices to ensure fiscal integrity.

The Division Chief and his staff represented the Division and the Department of Agriculture in all matters relating to fish and wildlife resources. This frequently entailed meetings with other agencies of the Government of Guam, various Federal agencies, and the military.

Division staff made a number of off-island trips related to Federal Aid programs. Division Chief Harry Kami attended the Federal Aid Coordinators meeting which was held in Sacremento, California.

Wildlife Biologist Robert Beck traveled to Rota to investigate prospective release sites for the introduction of the Guam Rail to Rota. He was accompanied on this trip by Dr. Stuart Pimm, Professor of Zoology at University of Tennessee, who will be monitoring the success of the introduction project for several years. While on Rota, they met with various officials of the Commonwealth of the Northern Mariana Islands and Rota municiple governments.

Wildlife Biologist Gary Wiles spent five days on Rota, conducting surveys of Marianas fruit bats in conjunction with biologists from the Commonwealth of the Northern Mariana Islands (CNMI).

Fishery Biologists Robert Myers and Gretchen Grimm traveled to Honolulu to attend a workshop on data processing theory and application for fisheries surveys. While at the workshop they met with various state and federal officials and discussed issues of mutual interest, including fish aggregating devices.

Assistant Chief Robert D. Anderson visited the Regional Office in Portland while on vacation in July and spent the day discussing Federal Aid and Endangered Species programs with Region staff. He also attended the September meeting of the Pacific Basin Development Council on Saipan and participated in presenting a briefing on the brown tree snake problem to the members.

The Division hosted a number of off-island visitors during the year. Ernie Kosaka, John Ford, Derral Herbst, and Tom Fritts, all of the U.S. Fish and Wildlife Service, visited the office at various times. Special Agents Ed Eckhoff and Joe Wong of the National Marine Fisheries Service also visited.

William Donaldson, Wilbur Amand and Robert Snyder, all of the Philadelphia Zoological Society and who are actively involved in the captive breeding programs for the Guam Rail and the Micronesian Kingfisher, visited and toured both our captive breeding facilities and native bird habitat in Northwest Field.

Numerous representatives of the CNMI Department of Natural Resources, including Biologists Phil Glass, Jim Reichal, Stan Villagomez and Stan Taisapic, visited during the year to discuss subjects of mutual interest.

The Division experienced several staff changes during the year. Fishery Biologist II Robert Rinehart, Wildlife Biologist III Julie Savidge, Wildlife Biologist I Georganne Neubauer, and Biological Aid Donald S. Klotzback resigned during the year. Gerry Davis rejoined the staff as Fishery Biologist II. Additions to the staff also included Conservation Officers Leonard Z. Iriarte and Michael A. Reyes.

Report prepared by: Robert D. Anderson

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: C-2
JOB NO.: 1

PROJECT TITLE: Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources

JOB TITLE: Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources

PERIOD COVERED: October 1, 1986 to September 30, 1987

BACKGROUND

The rapid development of Guam's economy has placed increasing demands upon Guam's natural resources. A trend toward urbanization has brought growth in the construction of residential, recreational, commercial, military, industrial, and public utility facilities, all of which have some impact upon the environment. To help minimize long-term adverse impacts of such development, the Division of Aquatic and Wildlife Resources (DAWR) has taken an increasingly active role in the area of technical guidance. Recently, the DAWR's responsibilities in this area have been increasing rapidly because review is now legally required for many development plans, permit applications, and impact statements.

OBJECTIVES

1. To minimize adverse impact resulting from the construction of recreational, commercial, residential, industrial or public utility facilities.

2. Provide technical assistance to military and civil agencies relative to the management and protection of fish and wildlife resources.

FINDINGS

The staff of the Division has been actively involved in the technical guidance function during this segment. Numerous development plans, impact statements, and permit applications have been submitted to the Division for review. Field investigations and meetings with responsible agencies have been conducted in many cases as a part of the review process.

Various Division staff members actively serve as members of the following groups:

1. Cocos Lagoon Task Force
2. Region IX Regional Response Team - Oceania
3. Brown Tree Snake Task Force
4. Subdivision and Development Review Committee
5. Agricultural Lease Committee
6. Melon Fly Task Force

Members of the Division have attended numerous meetings and hearings pertaining to the protection of Guam's natural resources and have actively consulted with various civil and military agencies on environmental matters. Division staff maintain close liaison with the Department of Land Management, Department of Parks and Recreation, Guam Bureau of Planning, Guam Environmental Protection Agency, U.S. Army Corps of Engineers (ACOE), the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the U.S. Navy, the U.S. Coast Guard, the U.S. Air Force regarding matters of environmental concern. In addition, staff members actively consulted with the numerous off-island visitors, representing various agencies and organizations, who visited during the segment.

Considerable public contact was maintained by Division staff during the reporting segment. In addition to occasional interviews on radio, television, and in newspaper, staff members participated in National Wildlife Week, Chamorro Week, Earth Week and Environmental Fair activities and gave talks to a number of civic groups, sportsmans clubs, and school and university classes.

Some specific Technical Assistance activities included:

1. The Division was represented on the Subdivision and Development Review Committee, which met bi-weekly to review applications for rezoning, variances, and various types of development. The Division's input at this level is very important in ensuring that the protection of Guam's fish and wildlife resources be considered in land use planning.

2. The Division provided technical assistance to Andersen Air Force Base regarding the problem of excluding deer from flightline areas and reducing populations to optimum levels. This assistance included providing information, technical advice and special either-sex control hunts.

3. The Division reviewed several proposed subdivision developments for potential impacts on endangered species. Because these projects were to be federally financed, the developers and the funding agency (Farmers Home Administration) were also referred to the U.S. Fish and Wildlife Service.

4. The Division responded to a request by the US Fish and Wildlife Service for input and comments on the proposed clean-up of refuse dumped by the Air Force on privately-owned land in the Urunao Basin area. This information was needed for the Endangered Species Section 7 Consultation on the project.

5. The Division reviewed and commented upon several legislative bills that would affect fish and wildlife resources.

6. The Division reviewed and commented upon TSPC Seashore Clearance and ACOE permit applications to dredge an area of east Agana Bay for the purpose of improving disposal of stormwater runoff and to provide an area for the commercial operation of mechanized aquatic recreational vehicles such as jet skis.

7. The Division assisted in the preparation of several Agricultural Impact Statements which are required in cases involving the rezoning of lands zoned "A" (Agricultural). In cases where the proposed rezoning would have negative impacts on the conservation of wildlife resources recommendations were made to disapprove the proposed rezoning.

8. The Division reviewed and commented on several proposals to dispose of government land through sale or exchange and made appropriate recommendations for the conservation of wildlife resources.

9. The Division reviewed and commented upon a proposed Executive Order authored by the Bureau of Planning that would regulate the use of mechanized aquatic recreational vehicles such as jet skis.

10. The Division answered several queries regarding the feasiblilty of introducing mongooses for control of the brown tree snake.

11. The Division investigated several reports of suspected fish kills in Apra Harbor and elsewhere on the island during the year.

12. The Division responded to many requests for information on laws and regulations pertaining to fish, wildlife, endangered species, hunting and fishing and importation of wildlife.

13. The Division responded to many requests for information on native wildlife, particularly endangered species.

14. The Division reviewed and commented upon Navy plans and Preliminary Environmental Assessments to construct facilities for the Maritime Prepositioning Ships program.

15. The Division reviewed and commented upon a review of potential sites for a new cemetary in northern Guam that was conducted by the Department of Parks and Recreation.

16. Division staff met periodically with supervisors of the Customs and Quarantine Division to discuss animal imports and endangered species questions.

17. The Division Chief served as the Departments Response Activity Coordinator with Civil Defense. Division staff were involved in conducting natural resource damage assessment in the aftermath of Typhoon Lynn.

18. The Division reviewed and commented upon the ACOE application to fill 2.5 acres of wetland in Agana Swamp for the expansion of the Agana Shopping Center. Mitigation recommendations were included in the comments.

19. The Division answered numerous requests for information on hunting from both on and off-island individuals. Specific requests included information on protective coloration, bow hunting, and laws and regulations.

20. The Division provided information and technical recommendations to the Attorney General's office regarding needed revisions to the regulations regarding fish weir permits.

21. The Division reviewed and commented upon excessive clearing that took place as a part of a Navy fiber optic cable installation in Northwest Field. Technical advice and review of a site rehabilitation plan was also provided to the Navy contractor.

22. The Division reviewed and commented upon the ACOE and SDRC applications for the construction of an underwater observatory in Piti Bay.

23. Division staff provided technical assistance to the Air Force on several occasions by identifying the remains of birds and bats involved in collisions with aircraft.

24. The Division reviewed and commented on the latest version of the Army Corps of Engineers Agana River Flood Control Plan and attended meetings to review the supplemental EIS.

25. The Division reviewed and commented upon a Bureau of Planning study entitled Public Access To Shoreline Areas.

26. Division staff conducted site inspections and prepared comments to the ACOE on the illegal filling of an area in the Agana wetland by a landowner.

27. Division staff reviewed and commented upon draft management plans for the Navy's Ecological Reserves at Haputo and Orote Point.

28. The Division investigated a suspected sewage/oil spill near the Marianas Yacht Club in conjunction with the Guam Environmental Protection Agency and the US Coast Guard.

29. Division staff provided technical assistance to numerous farmers and the Air Force and the Navy regarding pig damage. Damage control permits were issued when warrented.

30. The Division investigated a chronic oil leak at the Tanguisson Power Plant in conjunction with the Guam Environmental Protection Agency.

31. Several Division staff reviewed manuscripts for other authors and for professional journals.

32. The Division reviewed and commented upon the Army Corps of Engineers permit to install a floating platform in a swimming area at Port Authority Beach in Apra Harbor.

33. Division staff provided technical assistance in developing a master permit system for aquaculture developments.

34. The Division provided technical assistance and review of the draft Natural Resources Management Plan for Andersen Air Force Base. Included in the assistance provided was a draft proposal for the establishment of a marine conservation area a Tarague Beach.

35. The Division reviewed a proposal by the the Navy's Ship Repair Facility (SRF) to conduct Underwater Demolition Team (UDT) training within the graving dock basin at SRF. The recommendation was made that this site be considered for permanent designation as an underwater explosive training area, as adverse environmental impacts would be minimal.

36. The Division provided technical assistance to the South Pacific Commission by reviewing annual work plans providing information on fishing activity, and reviewing a Tuna/Billfish assessment.

37. Division staff provided technical assistance to the Division of Forestry and Soil Resources and to the Attorney Generals Office in investigating and prosecuting a case in which a survey contractor bulldozed native limestone forest on Government of Guam land without proper permits.

38. Division staff participated in the Sea Grant Summer Fisheries Workshop, making several presentations to the enrollees.

39. The Division participated in the Bureau of Planning's Land Use Task Force and provided input to the Task Force on land-use laws and regulations that affect fish and wildlife resources.

40. The Division provided technical assistance to the Attorney General's Office in identifying fish killed illegally with explosives, hair and other tissues from suspected deer and pig carcasses, and in interpreting the laws and regulations that apply to fish and wildlife resources.

41. Division staff attended hunter safety briefings at Andersen Air Force Base to provide pertinent information to hunters.

42. Division staff made presentations on fish and wildlife resources at meetings of numerous clubs and other organizations during the year.

43. Division staff prepared numerous press releases to keep the public informed of fish and wildlife issues including hunting seasons, laws and regulations, endangered species, fish and wildlife importation, etc.

44. The Division reviewed and commented upon a proposal by the Navy to remove four unexploded Japanese depth charges from the wreck of the TOKAI MARU in Apra Harbor and detonate them in the harbor. The removal and detonation was intended to remove a significant hazard to recreational divers who visit the wreck. The recommendation was made that the depth charges be removed from the wreck and towed into deep water outside Apra Harbor where they could either be detonated with minimal

environmental damage, or jettisoned and sunk in deep water where they would no longer present a hazard.

45. The Division provided information to the Department of Commerce on fisheries harvest and participation in the Merizo area.

46. The Division provided information to the South Pacific Commission regarding Guam's commercial and Subsistence Fishery.

47. The Division reviewed and commented upon an application by the Navy for an Army Corps of Engineers permit to install a mooring at the site of the wreck of the TOKAI MARU in Apra Harbor for the use of recreational divers.

48. Technical assistance was provided to the Marianas Fishing Derby.

49. Technical information on the state of Guam's fish and wildlife resources was provided to the Guam Environmental Protection Agency for their annual report.

50. The Division reviewed and commented upon an ACOE permit application for the replacement of the Mobil Fuel pier at Cabras Island.

51. The Division reviewed and commented upon an illegal fill in the Talofofo River caused by an aquaculture development and a wetland permit application by the same developer.

52. Technical assistance and logistical support was given to Dr. Thomas Fritts of the U.S. Fish and Wildlife Service and Mr. Larry Shelton of the Philadelphia Zoo, each of whom spent time on Guam consulting with Division staff on the brown tree snake and native bird recovery projects, respectively.

53. The Division was involved in several meetings with the Department of Parks and Recreation, Commerce, Public Works, and the Port Authority of Guam to assess the public needs for boating access development. The Division reviewed and commented upon plans for boat ramps to be constructed in Umatac Bay, at the Harbor of Refuge, and Merizo.

54. The Division provided information to the Navy on the presence of the endangered Mariana Moorhen at Naval Station. Similar information was provided to the Department of Corrections regarding moorhen nesting in a ponding basin on the prison grounds.

55. The Division worked closely with the Navy and Fish and Wildlife Service in completing the revision of the Sikes Act Cooperative Agreement with Naval Magazine and establishing new agreements with six other Naval installations on Guam.

56. The Division reviewed and commented on the proposed Andersen Air Force Base Hunting Regulations and worked closely with their staff in planning a special either-sex control hunt for deer.

57. The Division provided technical assistance and logistical support to Dr. Tom Fritts of the U.S. Fish and Wildlife Service who is researching control and

containment of the brown tree snake in cooperation with the Division and with the Brown Tree Snake Task Force.

58. The Division reviewed and commented upon a proposal to contract a full service restaurant and to clear vegetation behind the recreation area at Tarague Beach on Andersen Air Force Base.

59. Division staff conducted a site inspection of government land that was being considered for lease to a rock quarry operation and made recommendations for the protection of limestone forest and wildlife resources in the area.

60. Division staff reviewed and commented upon a proposal of the Department of Education to develop the Anao Nature Center adjacent to Andersen Elementary School.

61. The Divisions Fisheries staff provided training in the identification of illegally taken fish and the proper technique for measuring lobsters to the Divisions Conservation Officers.

62. The Division was represented at Pacific Basin Development Council meeting which was held on Saipan and at which the members were briefed on the current status of the brown tree snake research and control program.

63. The Division investigated the appearance of a large number of seawasp jellyfish in the Ipao Beach area. Specimens were collected and identified and then pertinent information was provided to the public through the press media.

64. The Division reviewed and commented upon an Army Corps of Engineers proposal for a general permit for the aquaculture industry.

65. The Division provided information on sea turtle population survey methods to the National Marine Fisheries Service.

66. Division responded to questionnaire surveys on wildlife relocation projects, the Wallop-Breaux program, and assaults on Conservation Officers.

67. The Division provided technical assistance to the Guam Environmental Protection Agency and Army Corps of Engineers in assessing the impacts fo underwater blasting in Apra Harbor required for proper placement of caissons for the Navy's new ammunition wharf at Adotgan Point.

68. Division staff conducted site inspections and prepared comments to the Navy and other concerned agencies regarding illegal construction and fill activity in a wetland area at Naval Station.

69. The Division provided technical assistance to the U.S. Fish and Wildlife Service through the preparation and review of draft recovery plans for endangered fruit bats, native forest birds, the Island Swiftlet, and the Mariana Moorhen.

70. The Division provided review and comments to the Department of Commerce regarding the Tumon Bay Master Plan.

71. The Division reviewed a proposal to rezone the private property at Urunao from "A" to "H" Resort-Hotel, conducted a site inspection, and prepared comments to the Territorial Planning Commission. Prior to submission to TPC, the property was rezoned by legislative action.

72. The Division answered an inquiry from the Speaker of the 18th Guam Legislature regarding gill net fishing at Naval Facility, Ritidian Point, Guam.

73. A Division staff member assisted the Commonwealth of the Northern Mariana Islands Fish and Wildlife Division in conducting surveys of Mariana fruit bats on the island of Rota.

74. The Division inspected the site of some unauthorized clearing of limestone forest by air Force personnel in the Tarague Beach area and submitted appropriate comments to the Base Commander, Andersen Air Force Base.

75. The Division prepared the required Environmental Assessments for the proposed introduction of the Guam rail to Cocos Island, Guam and to the island of Rota, Commonwealth of the Northern Marianas for submittal to the US Fish and Wildlife Service. After due consideration, Rota was chosen as the preferred site for the introduction project.

76. A member of the Division staff participated as a member of the IUCN Species Survival Commission for fruit bats, provided information on the trade in fruit bats, and reviewed and commented upon a CITES proposal to extend CITES protection to Pacific Island fruit bats.

77. The Division provided information on the brown tree snake to the Pacific Basin Development Council.

78. Division provided information the the Pohnpei State Government, Federated States of Micronesia regarding the continuing commercial exportation of mangrove crabs from Pohnpei in apparent violation of Pohnpei laws and regulations.

79. The Division commented upon the release of a quantity of ethelyne dioxide gas adjacent to the Orote Point Ecological Reserve by the Navy Public Works Center.

80. The Division reviewed and commented upon an instance in which the Navy conducted and Explosive Ordnance Disposal (EOD) training exercise inside Apra Harbor without obtaining proper advance clearance or conducting an adequate environmental impact review.

81. The Division prepared a "white paper" entitled The Ecologiocal and Economic Impact of the Brown Tree Snake on Guam and its Threat to Other Islands. This document was submitted to the Governor of Guam who used it as the basis for the formation of the Brown Tree Snake Task Force. The Document has been widely circulated in an effort to increase the awareness of the significant threat that this snake poses for the entire Pacific Basin.

82. The Division reviewed and commented upon the proposed listing of the tree *Serianthes nelsonii* as endangered.

83. The Division reviewed and commented upon the proposal of the Guam Housing and Urban Renewal Authority to construct ballfields in several communities on Guam.

84. The Division reviewed and provided technical input to the Attorney Generals office regarding a concurrent jurisdiction Memorandum Agreement with the military.

85. The Division investigated the environmental impacts of the grounding of the MV TOROS BAY on the Cocos Lagoon reef in conjunction with the Guam Environmental Protection Agency.

86. The Division reviewed and commented upon the Army Corps of Engineers Agana Bay Typhoon Storm Surge Protection Plan.

87. The Division provided comments to the Bureau of Planning on proposed rules regulating marine mining.

88. The Division reviewed and commented upon a plan to install new underwater cables at Tanguisson Point.

89. The Division notified the Navy of vegetation clearing being done in conjunction with the expansion of a quarry at Naval Station that could potentially damage *Heriteria longipetiolata* trees that are protected by Guams local Endangered Species Act.

90. The Division attended several meetings with the Department of Parks and Recreation to review and comment upon proposed regulations governing the salvaging of shipwrecks and marine archaeological resources.

91. The Division cooperated with a study of the potential relationship between the consumption of the seeds of *Cycas sp.* and the diseases "Lytigo" and "Bodig". A number of pigs harvested during legal hunts at Andersen Air Force Base were necropsied by military veterinarians. Valuable information on parasitism rates and general body condition of pigs was gained.

92. Division staff served on the site selection committee for a General Aviation Airport that is being proposed by the Guam Airport Authority. Recommendations were made for the protection of valuable agricultural and natural resources in the siting of the airport.

93. The Division reviewed and commented upon Preliminary Environmental Assessments prepared by the Navy for proposed projects to fence all of Naval Magazine and the Naval Supply Depot's fuel storage faciolity located in the Sasa Valley and Tenjo Vista area. Technical guidance was given on the wildlife management implications of these fencing projects and recommendations were made for the protection of the wildlife resource.

94. The Division reviewed and commented upon an ACOE permit application to install a raft in the Pago River.

95. The Division cooperated with Navy contractors who are preparing draft Natural Resource Management Plans for all the Naval installations on Guam. Technical advice and access to information was provided.

96. The Division reviewed and commented upon a Navy plan to remove a concrete platform from the reef near the USO through the use of explosives.

97. The Division responded to an inquiry from Andersen Air Force Base regarding the control of *Acanthaster* in the Tarague Beach area.

98. The Division reviewed the proposal for a "snake roundup" sponsored by a local business and made appropriate recommendations to the Governor and to the Brown Tree Snake Task Force.

99. The Division commented upon a proposal to remove the Tinian Monarch from the federal Endangered Species List.

Report prepared by: Robert D. Anderson

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: C-3
JOB NO.: 1

SUB-PROJECT TITLE: Public Information and Education of Guam's Fish and Wildlife Restoration and Endangered Species Programs

JOB TITLE: Public Information and Education

PERIOD COVERED: October 1, 1986 to September 30, 1987

OBJECTIVES

To inform and educate the public of the need to conserve, restore, and wisely manage the island's fish and wildlife resources as it can be accomplished through the Division's Federal Aid Programs.

RESULTS

This job was inactive throughout this segment due to funding uncertainties and lack of manpower.

RECOMMENDATION

Activate this job during the next segment provided adequate funding and manpower are available.

Report prepared by: Robert D. Anderson

GUAM FISHERIES INVESTIGATIONS
PROJECT FW-2R-24
Federal Aid in Sport Fish Restoration Act

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: F
STUDY NO.: F-1
JOB NO.: 1

JOB TITLE: Offshore Fisheries Survey

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Monthly offshore fisheries surveys were conducted at the Agana Boat Basin and other boat launching locations along Guam's shoreline from October 1986 through September 1987. An island-wide finfish catch is estimated at 189.3 metric tons (m.t.) for that period. The bulk of the catch, 167.2 m.t., consisted of five major pelagic species landed by trolling during an estimated 37,187 boat-hours of effort. Bottomfishing produced an estimated 11.7 m.t., primarily emperors and snappers, followed by spearfishing (6.0 m.t.) and night-light jigging for atulai (2.8 m.t.). Approximately 1.5 m.t. of finfish and shellfish were landed by spincasting, gill netting, or pelagic gill net. (Catches by infrequently encountered methods may be under-estimated as follows: night-light jigging for atulai (10%); spearfishing (13%); and other methods combined (33%)).

BACKGROUND

Effective management of the island's offshore fishery resources requires accumulating data on fishing pressure, types of fishing methods used and annual harvest. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatic and Wildlife Resources (DAWR) has been monitoring offshore fishing activities for the past ten years. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. Recently, however, major advances have been made in both field survey techniques and in the area of computerized statistical analysis. Much of this progress has resulted from the combined efforts of DAWR and National Marine Fisheries Service (NMFS) personnel through the Western Pacific Fisheries Information Network (WPACFIN) program (see Study F-1, Job 3).

OBJECTIVES

1. To quantify fishing participation, effort, and catch which occurs outside the reef margin in boats.

2. To collect biological data from the specimens examined during interviews.

PROCEDURES

During FY 87, interviews of returning offshore fishing parties were conducted on four days each month at the Agana Boat Basin. Two of these days were randomly selected

weekdays and two were randomly selected weekend days (which in this report includes holidays). Each survey consisted of two periods, one from 0500 to 1100 hours and the other from 1600 to 2400 hours.

Sampling and analytical procedures used in the GOES (Guam Offshore Expansion System) and by the Division remain unchanged from those outlined in the FY 85 annual report.

RESULTS

Trolling

An estimated 167.2 m.t. of troll-caught fish were landed island-wide during FY 87 (Table 1). Monthly catches ranged from a high of 26.8 m.t. in February to a low of 5.0 m.t. in August (Figure 1). An estimated 37,187 boat-hours were spent trolling with an average catch rate of 4.4 kg/boat-hour. Monthly CPUE (catch per unit effort) ranged from 6.8 kg/boat-hour in April to 1.0 kg/boat-hour in September.

The usual five pelagic species accounted for the bulk of the catch (93.9%; Table 2). Mahimahi (*Coryphaena hippurus*, 28.8%) was the most important species, followed by blue marlin (*Makaira nigricans*; 19.3%), wahoo (*Acanthocybium solandri*; 17.7%) skipjack tuna (*Katsuwonus pelamis*; 16.0%); and yellowfin tuna (*Thunnus albacares*; 12.1%). Scombrids collectively comprised 47.0% of the total trolling catch.

As in the previous year, FY 87 was marked by continuing declines in participation and catch as well as considerable shifts among the relative importance of the five major trolling species. The trolling catch was down 12% from the catch of FY 86 and 23% from the historically high catch of FY 85*. A drop in participation of 16% in island-wide boat trips accounted for the continuing decline in the catch. CPUE leveled off, remaining about the same as that of FY 86, but still down 17.9% from the 5.6 Kg/boat-hour of FY 85. Although the mahimahi catch recaptured the top spot, it was still 6% below last year's catch of 51 m.t. but somewhat better than the poor FY 85 mahimahi catch of 40 m.t. Catches of two of the four remaining top five species were also down from those of last year. The wahoo catch declined a whopping 58% from the all-time FY 86 high of 70 m.t., and the skipjack tuna catch continued to decline from the relatively high catch of FY 85, dropping about 51% over the last two years. The decline in importance of skipjack tuna in the troll catch is probably partly a result of poor market conditions in recent years. The species is not as highly esteemed as are the other troll-caught species and commands a poor price to those that sell part or all of their catch, so many fisherman are reluctant to target on them. The yellowfin tuna catch remained about the same as that of FY 86, but was still 51% below that of FY 85. The only bright spot in FY 87 was the blue marlin catch which exceeded the historical high of 28 m.t. in FY 85, jumping all the way from its usual spot as fifth to second in importance. As in FY 86, a small number of sailfish, which were not encountered during the FY 85 survey, were caught during FY 87 (1.7 m.t.).

* The field method of determining the number of berthed boats considered out of port during the instantaneous counts taken at the Agana Boat Basin was refined during FY 87. The annual number of island-wide boat trips for FY 87 based on the new method is 14.4% lower than that based on the old method. Comparisons cited in this report assume that the participation, effort, and catch data given in the FY 85 and 86 annual reports are inflated by a similar figure, and therefore reflect a 14.4% reduction in those figures. These changes do not affect previously calculated CPUE figures.

Bottomfishing

An estimated 11.7 m.t. of bottomfish were landed island-wide during FY 87 (Table 3). Monthly catches ranged from a high of 3.0 m.t. in May to a low of 0.2 m.t. in September. With the exception of July, monthly catches were generally good from May to August and poor the remainder of the year. An estimated 4,836 boat-hours were spent bottomfishing, resulting in an overall catch rate of 2.4 kg/boat-hour. Monthly catch rates ranged from 1.1 kg/boat-hour in November to 4.0 kg/boat-hour in December.

The estimated bottomfishing catch for FY 87 indicates a continuing precipitous decline (over 65%) from the historical high catch of 33.9 m.t. in FY 85. This is due primarily to drops of 53 to 63% in various measures participation and in small part to a drop of about 14% in CPUE (kg/boat-hour) during the past two years. Based on days in which participation occurred, but interviews were not obtained, it is believed that the GOES underestimated the bottomfish catch by approximately 3%.

Emperors (family Lethrinidae) and snappers (Lutjanidae) continued to dominate the Guam bottomfish catch, accounting for 44.1 and 20.4% of the weight landed, respectively (Table 4). The catch of emperors, which for the first time exceeded that of snappers in FY 85, rebounded, and for the first time, the estimated annual catch of shallow water snappers (57% of the snapper catch) exceeded that of deepwater snappers (*Etelis* spp., *Pristipomoides* spp.). The redgilled emperor (*Lethrinus rubrioperculatus*) was the single most important bottomfish species in FY 87, comprising 30.3% of the overall bottomfishing catch and 86.1% of the emperor catch. The most important shallow water snappers were taape (*Lutjanus kasmira*) and uku (*Aprion virescens*), each of which were more important than any single species of deepwater snapper. Groupers (Serranidae; 12.5%) ranked third in importance with three species (*Cephalopholis sonnerati*, *Epinephelus fasciatus*, and *Variola louti*) dominating. Other important families included the jacks (Carangidae; 10.3%), squirrelfishes (Holocentridae; 3.0%), tunas (Scombridae; 2.9%); barracudas (Sphyraenidae; 2.4%), triggerfishes (Balistidae; 1.8%), and goatfishes (Mullidae; 1.7%) which were landed primarily at relatively shallow depths.

Spearfishing

The estimated monthly and annual participation, effort, and catch for spearfishing from boats during FY 87 is summarized in Tables 5 and 6. (Readers should also refer to study F-1, Job 2 for estimates of spearing from shore, i.e., without the use of boats, to gain a more complete picture of FY 86 spearfishing activities on Guam.)

An estimated 6.0 m.t. of speared fish, crustaceans, and octopuses were landed from boats during FY 87. This represents a slight drop drop of 4% from the FY 86 catch, but a drop of 27% from the recent high catch of FY 85. An estimated 2,188 person-hours during 1,151 boat-hours of fishing effort were expended by spearfishers, the bulk of which was due to snorkeling (776 vs 291 boat hours, with 102 boat-hours unknown). The average catch rate for spearfishing was approximately 5.2 kg/boat-hour, down about 17% from the 6.3 kg/boat-hour of FY 85-86. Since some spearfishing parties return late at night outside our survey period and the GOES only considered complete interviews, we believe that the above estimates are low. Based on days in which participation in spearfishing occurred, but interviews were not obtained, it is believed that the GOES expansion for FY 87 underestimates the spearfishing catch by at least 13%.

As in previous years, parrotfishes (Scaridae; 26.1%) clearly dominated the FY 87 spearfishing catch (Table 7). Surgeonfishes (Acanthuridae; 8.7%), were a distant second, followed by groupers (Serranidae; 6.8%), jacks (Carangidae; 5.3%), rudderfishes

(Kyphosidae; 4.4%), sweetlips (Haemulidae; 3.5%), wrasses (Labridae; 2.9%), sharks (Carcharhinidae; 1.9%), squirrelfishes (Holocentridae; 1.7%), goatfishes (Mullidae; 1.4%), and snappers (Lutjanidae; 1.3%). Emperors (Lethrinidae), rabbitfishes (Siganidae), needlefishes (Belonidae), batfishes (Ephippidae), angelfishes (Pomacanthidae), and sweepers (Pempheridae) each accounted for less than 1% of the spearfish catch. In addition to fishes, an estimated 0.6 m.t. (10.8%) of molluscs (primarily octopuses) and crustaceans (primarily spiny lobsters) were harvested during FY 87.

Atulai Night-Light Jigging

Changes in the sampling period and method of determining participation implemented in FY 85 made it possible to account for the bulk of offshore atulai fishing during the past three years.

Atulai fishing was encountered from April to August 1987 and at least one interview was obtained during each of these five months. An estimated 2.8 m.t. of atulai were landed by night-light jigging from boats during FY 87, representing a precipitous drop of more than 82% over the last two years. This decline was due to the combination of declines in both participation (1,648 boat-hours vs. 3,707 boat-hours in FY 85) and CPUE (1.6 vs. 4.3 and 7.6 kg/boat-hour and FY 85 and 86, respectively) over the same time period. Based on days in which participation occurred, but interviews were not obtained, it is believed that the GOES underestimated the catch of this method by approximately 10%.

Other Methods

Other rarely encountered methods during FY 87 included gill-netting, spin casting, and pelagic gill-netting. Together, they produced an estimated catch of 1.6 m.t. during 433 boat-hours of effort. It is believed that the GOES underestimated the combined catch of these methods by about 33%.

Overview

Including the Guam International Fishing Derby (GIFD), an estimated 189.4 m.t. (90% confidence limit (CL) = 37.2 m.t.) of finfish (188.8 m.t.) and shellfish (0.6 m.t.) were landed island-wide by boats utilizing a variety of methods beyond the reef margin during FY 86. An estimated 7,823 boat trips were made in which 45,534 boat-hours were spent fishing. Excluding the GIFD, the average daily participation is estimated at 14.3 boats per weekday and 40.2 boats per weekend day or holiday. Including the GIFD, overall monthly catch rates (kg/boat-hour) ranged from 1.9 kg/ boat-hour in October to 6.5 kg/boat-hour in April with an average of 4.2, representing the third straight yearly drop, and a 29% drop from the 5.9 average of FY 84. Trolling accounted for 88.3% of the FY 87 catch (167.2 m.t., 90% CL = 36.3 m.t.), bottomfishing comprised 6.2% of the catch (11.7 m.t.; 90% CL = 4.4 m.t.), spearfishing accounted for 3.2% (6.0 m.t.; 90% CL = 3.9 m.t.) of the catch, night-light jigging for atulai accounted for 1.5% of the catch (2.8 m.t.; 90% CL = 1.9 m.t.), and other rare methods accounted for the remaining 0.8% (1.5 m.t.) of the catch.

Catches for all four of the major fisheries continued to drop or remained at approximately the same levels as those of FY 86. Poor weather can be blamed for a major portion of the drop in participation, particularly for methods other than trolling. However, lower CPUEs for bottomfishing and night jigging for atulai may have contributed to lower participation in those fisheries. A lack of interest in skipjack tuna by most local fishermen probably accounts for some of the recent decline in participation in the troll fishery as well as contributing to lower the CPUE, since that species is among the most easily caught. Major

changes in the composition of the troll catch are probably attributable to a combination of factors, including the impact of the western Pacific tuna purse-seine fishery on the bicatch as well as on tuna, large-scale oceanographic conditions related to the El Nino, and local market conditions. Declines in either CPUE or participation for bottomfishing and spearfishing are indicative of long-term heavy fishing pressure. Although weather and sea conditions have a major affect on bottomfishing, the decline in the relative importance of deep-water species (ca. 180 m) and the increasing importance of small species with high turnover rates (e.g. *Lethrinus rubrioperculatus* and *Epinephelus fasciatus*) is disturbing. It is quite likely that overfishing occurred during FY 84 and 85 (when 29 and 33 m.t. were taken, respectively).

RECOMMENDATIONS

A continued shortage of personnel during FY 87 made it impossible to extend the present survey to include the Merizo Pier. In order to maintain or improve the quality of the present survey it is anticipated that it will be necessary to extend it to cover the Merizo Pier as well as the soon-to-be completed Agat Small Boat Harbor. Unfortunately the recent rapid economic growth and developement of Guam has placed greatly increased demands on the fisheries staff for technical assistance. As a result it may not be possible to expand the survey for the next few years. Therefore, we recommend that this job continue at its present capacity and that sampling techniques continue to be refined. Furthermore, we recommend that staff fisheries biologists continue to work closely with NMFS personnel in improving the efficiency and accuracy of our computerized data analysis techniques, conduct a more detailed analysis of historical and current biological and survey data.

Report prepared by: Robert F. Myers

Table 1. Estimated monthly and annual trolling participation, effort, and catch during FY 87. Estimates include the GIFD. Weights are in kilograms (1 kg = 2.2 lbs).

A) PARTICIPATION:

MONTH	NO. OF PERSONS	SE	90% CL	NO. OF BOAT-TRIPS	SE	90% CL
OCT	2,079.1	679.7	1,599.3	692.8	248.9	585.6
NOV	2,402.0	378.8	891.4	723.5	56.4	132.8
DEC	1,311.5	198.3	466.5	512.3	133.4	313.9
JAN	2,182.4	210.6	495.5	751.1	114.8	270.2
FEB	3,202.7	1,613.7	3,797.0	830.6	374.1	880.2
MAR	1,162.7	161.7	380.4	409.4	48.7	114.7
APR	1,852.8	91.7	215.8	702.9	27.6	64.9
MAY	1,760.4	199.7	469.9	632.0	124.9	293.9
JUN	1,448.0	235.5	554.2	445.8	71.4	168.0
JUL	1,630.9	342.7	806.5	503.6	83.4	196.1
AUG	2,325.0	61.3	144.3	648.4	14.0	33.0
SEP	1,170.8	183.1	430.8	338.1	62.6	147.3
TOTAL	2,2528.3			6,982.1		
GOES	2,2649.0	1,900.3	3,200.2	7,169.0	500.8	843.4

B) EFFORT:

MONTH	NO. OF PERSON-HOURS	SE	90% CL	NO. OF BOAT-HOURS	SE	90% CL
OCT	8,902.6	3,806.3	8,956.3	3,047.9	1,319.6	3,105.1
NOV	12,588.0	1,175.3	2,765.5	3,829.1	219.0	515.2
DEC	7,806.2	1,182.7	2,782.8	3,212.5	1,038.6	2,443.9
JAN	9,886.1	1,582.3	3,723.1	3,566.5	767.5	1,805.9
FEB	16,486.8	7,918.1	18,631.2	4,396.2	1,976.9	4,651.7
MAR	6,181.1	1,261.0	2,967.0	2,286.5	399.7	940.4
APR	9,842.5	376.7	886.3	3,672.2	162.0	381.1
MAY	9,353.8	1,367.8	3,218.4	3,369.5	767.3	1,805.5
JUN	6,478.1	1,057.8	2,489.0	2,006.7	338.9	797.5
JUL	10,874.2	2,173.7	5,114.7	3,270.3	490.7	1,154.5
AUG	9,941.9	717.6	1,688.5	2,843.5	215.3	506.6
SEP	5,889.7	1,140.6	2,683.8	1,721.3	293.1	689.6
TOTAL	114,231.0			37,262.5		
GOES	115,141.5	9, 611.6	16,185.9	37,186.5	2,730.1	4,597.5

C) CATCH:

MONTH	NO. OF KILOGRAMS	SE	90% CL	Kg/B-T	Kg/B-H	Kg/P-H
OCT	6,053.7	3,832.6	9,018.2	8.7	2.0	.7
NOV	11,473.6	1,495.7	3,519.4	15.9	3.0	.9
DEC	15,558.2	8,238.1	19,384.2	30.4	4.8	2.0
JAN	16,829.8	7,448.0	17,525.0	22.4	4.7	1.7
FEB	26,823.8	16,250.4	38,237.1	32.3	6.1	1.6
MAR	9,581.8	4,015.7	9,448.9	23.4	4.2	1.6
APR	25,005.8	2,243.7	5,279.4	35.6	6.8	2.5
MAY	13,856.4	7,307.5	17,194.7	21.9	4.1	1.5
JUN	9,861.7	1,240.6	2,919.1	22.1	4.9	1.5
JUL	17,847.4	2,298.2	5,407.7	35.4	5.5	1.6
AUG	5,042.4	1,301.0	3,061.2	7.7	1.8	.5
SEP	6,751.5	2,968.7	6,985.3	20.0	1.0	1.1
TOTAL	164,723.3			23.6	4.4	1.4
GOES	167,187.2	21,563.4	36,312.7	23.3	4.5	1.5

Table 2. Monthly and annual composition of the Guam trolling catch during FY 87. Estimated weights are in kilograms and include the GIFD.

FAMILY and SPECIES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	FY87	% of total
Carcharhinidae														
Carcharhinus albimarginatus									809.6				809.6	0.5
Carcharhinus galapagensis	292.5												292.5	0.2
Belonidae														
Ablennes hians		22.3								2.2			24.5	<0.1
Serranidae														
Variola louti	5.1												5.1	<0.1
Carangidae														
Carangoides orthogrammus											17.1		17.1	<0.1
C. melampygus											68.4		68.4	<0.1
C. papuensis											19.1		19.1	<0.1
Elagatis bipinnulatus			482.9		81.3			14.1		70.6	242.7	61.8	953.4	0.6
Scomberoides lysan											9.5		9.5	≤0.1
Unid. sp.							8.9			12.2			21.1	<0.1
Coryphaenidae														
Coryphaena hippurus	334.5	1,307.7	717.8	11,496.2	20,423.9	2,106.6	9,524.3	1,210.6	24.8	244.0		21.7	47,412.1	28.8
Lutjanidae														
Aphareus furcatus	5.1						6.5	63.3			27.9		102.8	<0.1
Aprion virescens										48.9			48.9	<0.1
Labridae														
Cheilinus chlorourus											2.9		2.9	≤0.1
Sphyraenidae														
Sphyraena barracuda	19.1	156.1	502.7	791.0	1,056.7	36.7			45.3	960.5	87.5	195.1	3,850.7	2.3
Scombridae														
Acanthocybium solandri	577.5	1,823.5	6,416.0	2,604.0	2,056.0	5,694.7	5,488.2	2,444.8	235.3	314.2	775.0	710.1	29,139.5	17.7
Euthynnus affinis				262.3				15.7			179.7	99.7	557.4	0.3
Gymnosarda unicolor	967.8		65.9		270.2		25.2					86.7	1415.8	0.9
Katsuwonus pelamis	978.1	2,908.1	3,424.2	1,390.2	2,161.2	297.1	1,876.1	3,101.8	3,999.2	3,083.7	1,427.5	1,649.9	26,297.1	16.0
Thunnus albacares	838.2	1,594.9	3,948.8	286.2	774.6	248.9	2,408.9	1,842.6	3,497.5	2,833.6	873.7	794.6	19,942.5	12.1
Unid. sp.										8.2			8.2	<0.1
Istiophoridae														
Istiophorus platypterus							851.4	457.5				343.6	1,652.5	1.0
Makaira nigricans	2,035.1	3,661.0				1,198.0	4,549.3	4,705.6	1,250.0	10,269.3	1,311.3	2,788.2	31,767.8	19.3
Tetrapterus angustirostris							267.0						267.0	0.2
TOTAL	6,053.0	11,473.6	15,558.3	16,829.9	26,823.9	9,581.8	25,005.8	13,856.4	9,861.7	17,847.4	5,042.4	6,751.5	164,685.3	

Table 3. Estimated monthly and annual Guam bottomfishing participation, effort, and catch during FY 87. See text for explanation.

A) PARTICIPATION:

MONTH	NO. OF PERSONS	SE	90% CL	NO. OF BOAT-TRIPS	SE	90% CL
OCT	275.7	132.1	310.8	118.9	57.6	135.6
NOV	164.7	151.5	356.5	58.1	53.5	125.8
DEC	163.6	77.5	182.4	76.8	40.3	94.8
JAN	184.0	134.5	316.6	86.9	65.8	154.9
FEB	165.9	107.5	252.9	76.0	49.1	115.4
MAR	57.6	10.9	25.6	23.0	0.2	0.6
APR	102.5	32.8	77.1	47.4	13.0	30.5
MAY	425.0	97.6	229.7	206.9	44.0	103.5
JUN	704.4	364.4	857.3	262.4	121.6	286.1
JUL	153.2	85.9	202.1	51.6	29.5	69.4
AUG*	529.3	0.2	0.5	199.3	3.8	8.8
SEP	39.0	22.2	52.3	23.0	8.1	19.0
TOTAL	2964.9			1234.7		
GOES**	2999.2	562.8	947.7	1240.6	210.8	355.0

B) EFFORT:

MONTH	NO. OF PERSON-HOURS	SE	90% CL	NO. OF BOAT-HOURS	SE	90% CL
OCT	1101.7	601.2	1414.7	475.4	258.6	608.4
NOV	713.8	656.6	1545.0	251.9	231.7	545.3
DEC	237.5	76.2	179.2	103.8	37.2	87.6
JAN	352.0	234.3	551.3	160.8	109.7	258.0
FEB	679.6	441.2	1038.1	311.1	200.8	472.5
MAR	132.7	37.3	87.9	51.8	5.7	13.3
APR	282.9	4.6	10.8	133.4	4.8	11.2
MAY	1978.9	705.2	1659.4	963.3	333.1	785.8
JUN	2933.0	1475.6	3472.1	1079.1	483.2	1136.9
JUL	933.6	786.3	1850.2	312.7	262.4	617.5
AUG	2263.7	164.0	385.9	853.8	78.1	183.9
SEP	190.5	143.6	337.8	102.2	65.7	154.5
TOTAL	11799.9			4819.8		
GOES	11922.9	2508.7	4224.7	4836.1	927.2	1561.5

C) CATCH:

MONTH	NO. OF KILOGRAMS	SE	90% CL	Kg/B-T	Kg/B-H	Kg/P-H
OCT	549.4	198.0	465.9	4.6	1.2	.5
NOV	267.8	246.4	579.7	4.6	1.1	.4
DEC	412.1	260.5	612.9	5.4	4.0	1.7
JAN	458.8	341.2	802.9	5.3	2.9	1.3
FEB	634.6	490.1	1153.2	8.4	2.0	.9
MAR	121.7	106.8	251.4	5.3	2.4	.9
APR	318.1	34.9	82.2	6.7	2.4	1.1
MAY	2974.9	1145.7	2695.9	14.4	3.1	1.5
JUN	2758.6	1497.3	3523.2	10.6	2.6	.9
JUL	402.3	251.1	590.8	7.8	1.3	.4
AUG	2343.1	178.0	418.8	11.8	2.7	1.0
SEP	211.5	156.9	369.1	9.2	2.1	1.1
TOTAL	11452.9			9.3	2.4	1.0
GOES	11671.9	2626.5	4423.1	9.4	2.4	1.0

*Results are based on a 28 day expansion on the assumption that bottomfishing was negligible during the three day GIFD.

**Results are based on a 362 day expansion based on the assumption that bottomfishing was negligible during the three day GIFD.

Table 4. Composition of the Guam bottomfishing catch during FY 87. Estimated weights are in kilograms. Percentages are based on the differentiated portion of the catch only.

FAMILY	WEIGHT (Kg)	%
Carcharhinidae (Requiem sharks)	15.9	0.2
Holocentridae (Squirrelfishes)	277.3	3.0
Serranidae (Groupers)	1,150.7	12.5
Carangidae (Jack)	945.6	10.3
Lutjanidae (Snappers)	1,879.6	20.4
Lethrinidae (Emperors)	4,051.5	44.1
Mullidae (Goatfishes)	155.3	1.7
Sphyraenidae (Barracudas)	218.9	2.4
Labridae (Wrasses)	41.1	0.4
Scombridae (Tunas)	263.9	2.9
Balistidae (Triggerfishes)	166.7	1.8
Others*	29.2	0.3
SUBTOTAL	9,195.7	100.0
Undifferentiated	2,312.7	
TOTAL	11,508.4	

*Includes Synodontidae, Scorpaenidae, Malacanthidae, Pempheridídae, Acanthuridae, and Triodontidae, each of which comprised less than 0.1% of the catch.

Table 5. Estimated monthly and annual offshore spearfishing (with and without scuba) participation, effort, and catch during FY 87. See text for explanation.

MONTH	PARTICIPATION no. of Persons	no. of Boat trips	EFFORT no. of Person-hrs	no. of Boat-hrs	CATCH no. of Kilograms	Kg/ boat trip	Kg/ pers.-hr	Kg/ boat-hr
OCT	54.7	27.3	218.6	109.3	476.4	17.5	2.2	4.4
NOV	121.1	34.4	381.9	110.1	400.3	11.6	1.0	3.6
DEC	10.0	10.0	30.0	30.0	90.0	9.0	3.0	3.0
JAN	84.7	52.2	173.6	196.8	1121.1	21.4	6.5	5.7
FEB	29.3	4.9	22.0	3.7	46.3	9.4	2.1	12.5
MAR	no sample							
APR	92.5	67.6	255.6	196.2	1215.9	18.5	4.9	6.4
MAY	170.3	82.0	338.3	172.2	1267.7	15.5	3.7	7.4
JUN	71.4	28.2	297.1	126.1	171.7	6.1	0.6	1.4
JUL	36.0	24.7	109.4	94.7	551.4	22.3	5.0	5.8
AUG	149.2	60.6	287.1	122.5	623.0	10.2	2.2	5.1
SEP	no sample							
TOTAL	819.2	391.9	2113.6	1161.2	5963.8	15.2	2.8	5.1
GOES	856.0	396.0	2187.6	1150.5	6035.0	15.0	2.7	5.2

* Results are based on a 28 day expansion on the assumption that bottomfishing was negligable during the three day GIFD.

** Results are based on a 362 day expansion on the assumption that bottomfishing was negligable during the three day GIFD.

Table 6. Estimated annual Guam offshore spearfishing participation, effort, and catch by method during FY 87. See text for explanation.

A) PARTICIPATION:

	No. of Persons	SE	90% CL	No. of Boat trips	SE	90% CL
Snorkel	349.8	89.5	150.8	212.3	53.2	89.6
Scuba	346.1	126.9	213.7	136.9	46.7	78.6
Unknown or both	160.1	89.5	150.7	46.8	25.6	43.2
Total Spearfishing	856.0			396.0		

B) EFFORT:

	Person-hours	SE	90% CL	Boat-hours	SE	90% CL
Snorkel	1185.0	346.7	583.8	757.7	215.4	362.8
Scuba	637.0	232.3	391.2	291.2	105.5	177.6
Unknown or both	365.5	234.9	395.7	101.6	62.2	104.8
Total Spearfishing	2187.6			1150.5		

C) CATCH:

	No. of Kilograms	SE	90% CL	Kg/ boat trip	Kg/ pers.-hr	Kg/ boat-hr
Snorkel	3295.5	1074.8	1809.9	15.5	2.8	4.4
Scuba	2164.9	888.4	1496.1	15.8	3.4	7.4
Unknown or both	574.6	380.3	640.5	12.3	1.6	5.7
Total Spearfishing	6035.0			15.2	2.8	5.2

Table 7. Composition of the Guam spearfishing catch during FY 87. Percentages of finfish are of the differentiated portion of the finfish catch only.

FAMILY	SNORKEL (Kg)	%	SCUBA (Kg)	%	UNKNOWN OR MIXED (Kg)	%	TOTAL (Kg)	%
Carcharhinidae (Requiem sharks)			112.2	5.0			112.2	1.9
Belonidae (Needlefishes)	13.5	0.8					13.5	0.3
Holocentridae (Squirrelfishes)	3.8	0.1	33.8	1.5	65.4	9.9	103.0	1.7
Serranidae (Groupers)	192.2	6.3	196.3	8.7	19.6	3.0	408.2	6.8
Carangidae (Jacks)	292.3	9.6			24.0	3.7	316.3	5.3
Lutjanidae (Snappers)	26.4	0.9	49.8	2.2			76.2	1.3
Haemulidae (Sweetlips)	34.5	1.1	175.3	7.7			209.8	3.5
Lethrinidae (Emperors)			13.4	0.6	37.0	5.6	50.4	0.8
Mullidae (Goatfishes)	14.7	0.5	45.4	2.0	22.2	3.4	82.3	1.4
Pempheridae (Sweepers)	1.0	<0.1					1.0	<0.1
Kyphosidae (Rudderfishes)	38.5	1.3	224.2	9.9			262.7	4.4
Ephipidae (Batfishes)			4.9	0.3			4.9	0.1
Pomacanthidae (Angelfishes)					2.7	0.6	2.7	<0.1
Labridae (Wrasses)	164.1	5.4	7.2	0.3			171.3	2.9
Scaridae (Parrotfishes)	768.4	25.3	724.3	32.0	64.4	9.8	1,557.1	26.1
Acanthuridae (Surgeonfishes)	235.8	7.8	41.0	1.8	242.0	36.8	518.8	8.7
Siganidae (Rabbitfishes)	3.8	0.1	13.1	0.6			16.9	0.3
Subtotal	1,798.0	58.8	1,641.2	72.4	477.3	72.6	3,907.6	65.5
Undifferentiated Fishes	1,028.2	33.8	381.7	16.8			1,409.9	23.6
TOTAL (Finfishes)	2,817.2	92.6	2,022.9	89.3	477.3	72.6	5,317.5	89.2
Gastropods					53.3	8.1	53.3	0.9
Octopuses & Squids	110.6	3.6	26.9	1.2	97.5	14.8	235.0	3.9
Crabs			44.1	1.9			44.1	0.7
Spiny Lobsters	106.1	3.5	167.3	7.4	19.5	3.0	292.9	4.9
Slipper Lobsters	7.5	0.2	4.5	0.2	9.7	1.5	21.7	0.4
Shellfish Subtotal	224.2	7.4	242.8	10.7	180.0	27.4	647.0	10.8
TOTAL	3,041.4	51.0	2,265.7	38.0	657.3	11.0	5,964.5	100.0

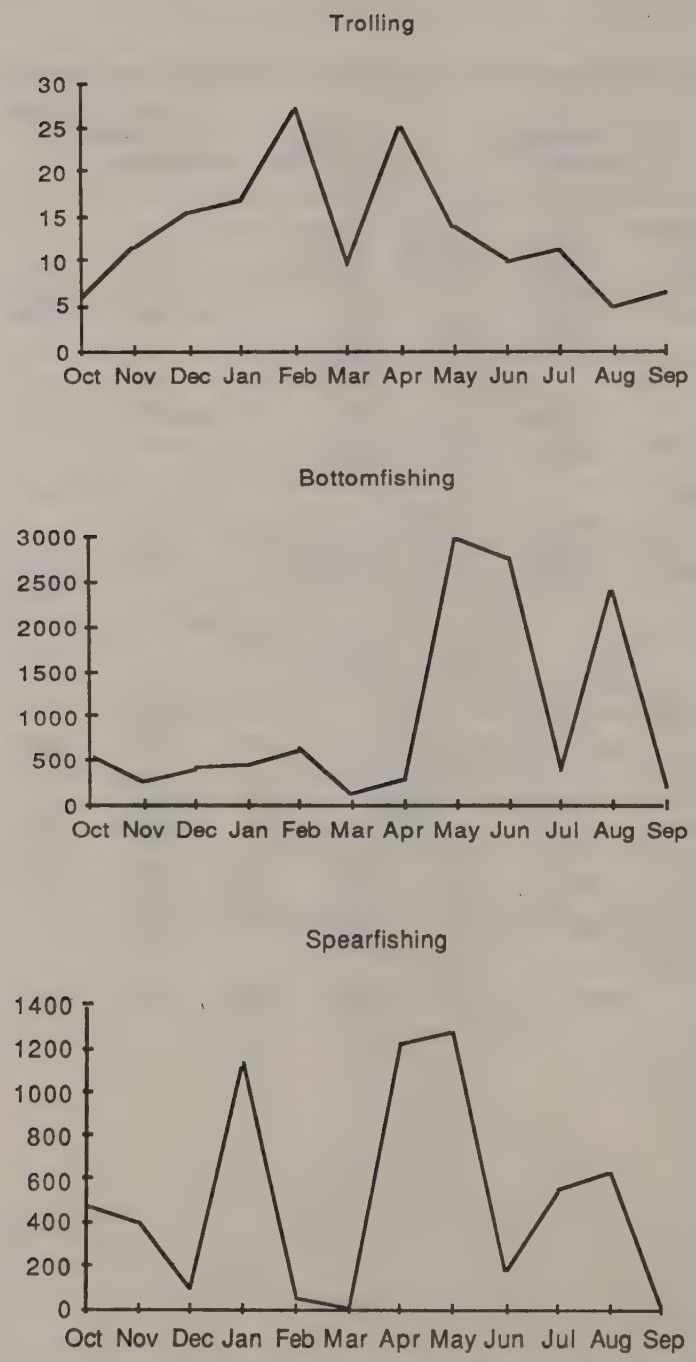

Figure 1. Monthly fluctuations in the estimated Guam offshore fish landings during FY 87. The troll estimate includes the GIFD. Note that weights for trolling are in metric tons and weights for bottomfishing and spearfishing are in kg.

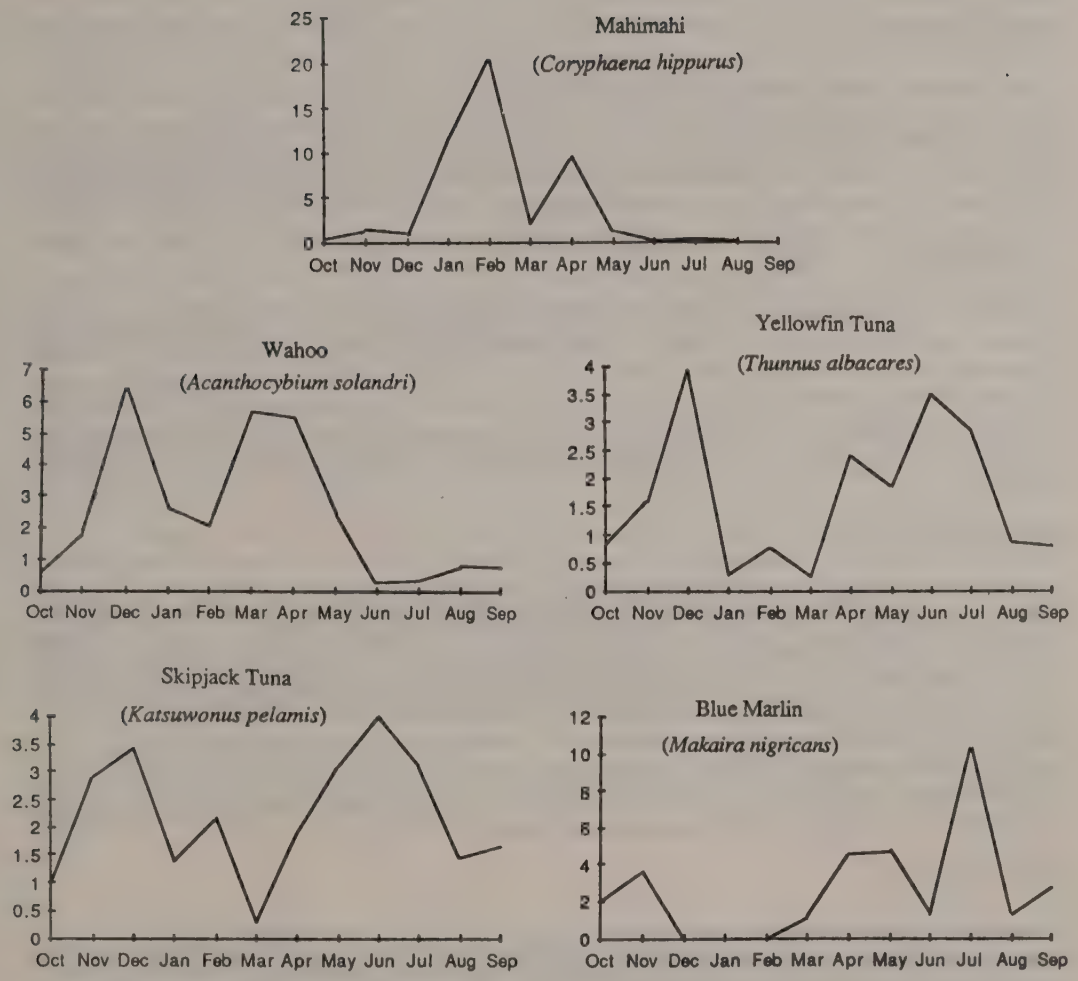

Figure 2. Monthly fluctuations in the estimated landings of Guam's major troll-caught species during FY 87. Estimates include the GIFD. Weights are in metric tons.

PROJECT TITLE: Guam International Fishing Derby

PERIOD COVERED: July 18-20, 1987.

INTRODUCTION

The eleventh Guam International Fishing Derby (GIFD), sponsored by the Hafa Dai Kiwanis Club, was held on July 18, 19, and 20, 1987. The fisheries biologists from the Division of Aquatic & Wildlife Resources (DAWR) wish to thank the Kiwanis Club as well as the Guam Fishermen's Cooperative, and the competing anglers for their cooperation and assistance in providing the catch information that made this report possible. This cooperation always helps make our job easier and more enjoyable and insures a more accurate collection of data.

Awards were presented to the anglers who landed the first, second, and third heaviest fishes of the following species: blue marlin *(Makaira nigricans)*, yellowfin tuna *(Thunnus albacares)*, wahoo *(Acanthocybium solandri)* and mahimahi *(Coryphaena hippurus)*. As in the past derbies, awards were also given for the greatest 3-day total number of fish caught in the above categories combined, as well as for the largest fish caught in a ladies category, and in a children under age 16 category. Records were also kept in an "other species" category.

PARTICIPATION

As in the past, onshore check-out/check-in stations were set up at the Agana Boat Basin and the Merizo Pier. Daily participation information is listed in Table 1. At least 97 boats participated in this years derby, a slight increase over last years participation. Daily participation ranged from 58 to 97 boats, totaling 218 boat-days with 142 (65%) of these trips originating from the Agana Boat Basin. This represents a more than doubling of the use of the Merizo Pier station over last year's. Each boat carried an average of 2.7 anglers and pulled an average of 4.4 lines per day, compared to last year's figure of 2.9 anglers per trip pulling an average of 4.2 lines. The mean time spent on the water was 9.7 hours per day per boat, of which 9.1 hours were spent fishing.

THE CATCH

A record 5,221.0 kg of derby species were caught during the 1987 GIFD (Table 2). This was due entirely to a record 4,008.3 kg catch of blue marlin. Including the bicatch, which accounted for 60% of the fishes but only 21.7% of the weight, a record 488 fish weighing 6,668.3 kg were caught. The mean catch per boat per day was 30.5 kg, nearly twice the 17.7 kg per boat trip per day of last year's GIFD. Like the overall catch rate, the catch rates for each of the derby species except mahimahi were considerably higher than those of last year's derby (Table 3). The catch rate for blue marlin greatly exceeded those for all other species (2.14 vs .02 to .46 kg/boat-hour fished). Unlike last year, the bulk of this year's catch was taken in the south, on the southern banks.

Although not quite as many blue marlin were caught in the 1987 derby as the 1986 and 1984 derbies (43 vs 47) their collective weight of 4,008.3 kg greatly exceeded that of the previous record 1986 catch of 2,859.1 kg. This was due to the relatively large average size of 93.2 kg. However, this year's winning marlin of 188.0 kg was exceeded on four out of the 10 previous derbies.

The estimated yellowfin tuna catch of 858.4 kg was more than double that of last years derby (406.0 kg), but smaller than that of the 1981, 1982, 1983, and 1985 derbies. Although the estimated 116 individuals caught was exceeded on only two previous derbies, the average size (7.4 kg) and winning fish (26.8 kg) were relatively small.

The catch of 31 wahoo weighing 314.2 kg was considerably better than last years extremely poor catch (16 fish weighing 136.7 kg), but far below the 1985 record of 98 fish weighing 921.6 kg. The average weight of 10.1 kg was slightly higher than last year's 8.5 kg average. The winning wahoo of 16.7 kg was the smallest on record.

The poor mahimahi catch of 3 fish weighing 40.1 kg was typical of the summer season. The winning mahimahi was relatively large, weighing 15.6 kg, only slightly smaller than the record 1980 mahimahi of 15.9 kg.

At least five "non-derby" species were landed accounting for the bulk of the individual fishes (295 or 60%) and 21.7% (1,447.3 kg) of the overall derby catch. The bulk of the bicatch consisted of barracuda (890.1 kg) followed by skipjack tuna (481.4 kg), uku (48.9 kg), rainbow runner (24.7 kg), and oceanic needlefish (2.2 kg).

FISHING AREAS

The majority of the boats utilized the Agana Boat Basin during the 1987 GIFD, although there was a significant increase in the use of the Merizo Pier station. Due to poor compliance in turning in catch reports, it was not possible to accurately determine catch or effort by area. However, area information was available for nearly half of the individuals of derby species caught (Table 4). Most of the catch (89% of the individual fishes and 79% of the weight) with accompanying area information was taken off the southern banks. The information available indicates that the southern banks were by far and away the most productive areas during the 1987 GIFD. This is consistent with the 1986 derby in which the best catch rates were also at the southern banks, although the much greater effort spent in the north in 1986 resulted in most of the catch coming from there as well.

Report prepared by: Robert F. Myers

Table 1. Daily participation, effort and catch in the eleventh annual Guam International Fishing Derby. Weights are expressed in kilograms (1kg=2.2 lbs).

	DAY 1 JULY 18	DAY 2 JULY 19	DAY 3 JULY 20	DERBY TOTALS
Number of boats	63	97	58	218
Number of fishermen	148	263	156	n.a.
Average men per boat	2.4	2.7	2.9	2.7
Number of lines fished*	277	419	272	965.0
Average lines per boat	-	4.3	4.1	4.4
Boat hours	693.4	938.0	474.9	2,107.2
Fished hours	660.9	886.6	444.1	1,868.9
Average boat trip length**	11.0	9.7	8.2	9.7
Average time spent fishing	10.5	9.1	7.7	9.1
Fisherman hours	1,631.6	2,542.0	1,353.6	5,527.2
Line hours†	2,910.6	3,812.9	2,094.4	8,817.9
Number of fish landed	176	236	241	653
Catch landed (kg)††	2,812.9	3,128.8	726.6	6,668.3
Kg/boat day	44.6	32.3	12.5	30.5
Kg/boat hour	4.05	3.34	1.53	3.16
Kg/man hour	1.72	1.23	0.54	1.21
Kg/line hour	0.97	0.82	0.35	0.76

* Artificial data based on the overall average lines per boat.
** Assumes one trip per day since calculation of number of boat trips per day was not possible.
† Based on actual time spent fishing and overall average lines per boat for day 1.
†† Includes incidental catch.

Table 2. Daily catch composition for the eleventh annual Guam International Fishing Derby. Weights are expressed in kilograms (1 kg=2.2 lbs).

	DAY 1 - JULY 18			DAY 2 - JULY 19			DAY 3 - JULY 20			TOTAL		
	NUMBER CAUGHT	TOTAL WT.	AVE WT.	NUMBER CAUGHT	TOTAL WT.	AVE WT.	NUMBER CAUGHT	TOTAL WT.	AVE WT.	NUMBER CAUGHT	TOTAL WT-KGS	AVE WT.
MARLIN	18	1,725.2	95.8	20	1,847.8	92.4	5	435.3	87.1	43	4,008.3	93.2
YELLOWFIN TUNA	64	462.4	7.2	35	323.6	9.2	17	72.4	4.3	116	858.4	7.4
WAHOO	16	175.4	11.0	9	81.9	9.1	6	56.9	9.5	31	314.2	10.1
MAHIMAHI	1	15.6	15.6	2	24.5	12.3	0	-	-	3	40.1	13.4
SKIPJACK TUNA	42	204.8	4.9	36	176.0	4.9	32	100.6	3.1	110	481.4	4.4
RAINBOW RUNNER	7	12.7	1.8	4	6.1	1.5	2	5.9	3.0	13	24.7	1.9
BARRACUDA	28	216.8	7.7	119	620.0	5.2	11	53.3	4.8	158	890.1	5.6
OTHER	0	-	-	11	48.9	4.4	3	2.2	0.7	14	51.1	3.7
TOTALS	176	2,812.9	16.0	236	3,128.8	13.3	76	726.6	9.6	488	6,668.3	13.7

Table 3. Catch comparison for all Guam International or Marianas Fishing Derbies[1]. Weights are expressed in kilograms (1 kg=2.2 lbs).

	1977	1978	1979	1980	1981	1982	1983	1984[2]	1985	1986	1987
MARLIN											
no. caught	9	9	6	12	34	12	13	47	17	47	43
total weight	933.0	511.0	703.0	727.0	2,005.0	852.0	964.1	2,840.4	1,659.7	2,859.1	4,008.3
ave. weight	103.6	56.8	117.2	60.6	59.0	71.0	74.2	60.4	97.6	60.8	93.2
winning fish	192.0	75.2	328.0	139.0	145.0	132.0	199.1	215.4	178.0	173.9	188.0
YELLOWFIN											
no. caught	18[3]	11	34	50	109	205	100	59	137	71	116
total weight	240.0	255.0	637.0	308.0	1,156.0	2,377.0	1,105.7	388.8	1,058.2	406.0	858.4
ave. weight	13.3	23.2	18.7	6.2	10.6	11.6	11.1	6.6	7.7	5.7	7.4
winning fish	46.3	56.8	67.7	51.1	47.7	61.1	55.7	51.7	45.9	46.0	26.8
WAHOO											
no. caught	7	9	11	12	33	60	36	46	98	16	31
total weight	90.9	102.0	116.0	161.0	543.0	264.0	359.7	466.1	921.6	136.7	314.2
ave. weight	13.0	11.4	10.5	13.4	16.5	4.4	10.0	10.1	9.4	8.5	10.1
winning fish	22.3	18.9	19.7	23.4	17.0	22.7	24.5	21.3	23.5	17.7	16.7
MAHIMAHI											
no. caught	2	4	5	3	1	14	33	0	14	7	3
total weight	13.6	26.4	52.6	39.3	0.8	63.7	195.2	-	76.6	61.5	40.1
ave. weight	6.8	6.6	10.5	13.1	-	4.6	5.9	-	5.5	8.8	13.4
winning fish	8.9	8.9	14.8	15.9	0.8	14.8	11.1	-	14.8	14.7	15.6
DERBY SPECIES CATCH											
no. caught	36	33	56	77	177	291	182	152	266	141	193
total weight	1,277.5	894.4	1,508.6	1,235.3	3,704.8	3,556.7	2,624.7	3,695.3	2,716.1	3,463.3	5,221.0
most fish per boat	-	-	-	-	-	-	-	-	-	-	57
TOTAL CATCH											
no. caught	-	-	-	-	-	-	281	336	427	237	488
total weight							3,277.6	4,365.2	4,370.2	3,794.0	6,668.3

[1]Based on returned catch reports for 1977 to 1983, but includes estimated bicatch and unreported catches for 1984 to present. Only the principal derby species are reported for 1977 to 1982.

[2]Based on known catches of principle derby species and estimated catches of non-derby species expanded for non-reporting boats.

[3]Includes all tuna species.

Table 4. Catches reported by area. Due to gaps in effort information it was not possible to calculate catch rates by area.

Area	Reported Catch (Kg)							
	Blue Marlin		Yellowfin Tuna		Wahoo		Mahimahi	
	no.	wt.	no.	wt.	no.	wt.	no.	wt.
North (all trips)	5	442.9	6	40.5				
Rota Bank	2	152.8	6	40.5				
45° Bank	1	120.4						
Ritidian	2	169.6						
NW and SW							2	24.5
South (all trips)	12	1,412.9	62	391.7	7	37.7		
Orote-Cocos	4	393.2	3	42.2	1	4.5		
SW Banks (all trips)	8	1,019.7	59	349.5	6	33.2		
11-mile Bank	1	92.4						
Galvez Bank	2	238.5	2	17.9				
Santa Rosa Bank	3	351.4	10	83.9	5	20.0		
White Tuna Bank			40	179.1				
All Coastal Trips	6	562.8	3	42.2	1	4.5	2	24.5
All Trips Including Banks	11	1,292.9	65	390.0	6	33.2		
Overall	17	1,855.8	68	432.2	7	37.7	2	24.5

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: F
STUDY NO.: F-1
JOB NO.: 2

JOB TITLE: Inshore Fisheries Survey

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Monthly inshore fisheries surveys were conducted along Guam's shoreline from October, 1986 to September, 1987. The total estimated catch for this time period was approximately 145.5 m.t., 86% of which were finfish. Hook and line fishing was the most popular method accounting for about 58% of the total participation and yielding 55.9 m.t., more than any other single method. Surround netting was the most successful method in terms of catch rate, yielding approximately 2.94 Kg/gear-hour. The surgeonfish (Family Acanthuridae) comprised 14.6% of the total finfish harvest followed closely by the jacks (Family Carangidae) at 14.5%. The estimated seasonal catch of juvenile rabbitfish (manahac) was an unusually low 2.0 m.t. for FY 87, while the estimated seasonal catch of bigeye scad (atulai) was about 19.0 m.t..

BACKGROUND

Effective management of Guam's inshore fishery resources requires accumulating data on the types of fishing methods used, fishing pressure, and annual catch. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatic and Wildlfie Resources (DAWR) has been monitoring marine fishing activities since the early 1960's. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. In the last several years, however, field survey techniques have been expanded and refined, while estimates of Guam's recreational/subsistence fishing activities have come to be based on more reliable data analysis techniques.

OBJECTIVES

1. To estimate the total annual inshore participation, effort and harvest of Guam's inshore recreational/subsistence fisheries through statistically valid surveys and analysis.
2. To gather limited biological data that will add to a long-term historical data base on Guam's important inshore fish species.

PROCEDURES

During FY 87, day and night "inshore participation" surveys were conducted on seven randomly selected days per month and included every type day of the week. These surveys entailed making visual observations of not only participation among the various fishing

methods employed, but also of the reef zones and general locations that were fished within the more readily accessible portions of Guam's coastline (Fig. 1, locations 1-72). Based on data collected during nine years of aerial surveys conducted between FY 63 and FY 79, approximately 85% of Guam's inshore fishing activities is known to occur within this area. The starting location for each survey was selected at random and the "circular" direction of driving was alternated between surveys. Observations were made while driving the route once without backtracking. These methods were applied for both day and night participation surveys.

In addition, four "inshore-catch" survey days were selected from the seven participation days. During these catch days, a fisherman-intercept survey was conducted to gather catch, effort, and species composition data for both day and night fishing. The day survey covered a six-hour interval (starting at 0630 hours) and the night survey covered a five-hour interval (starting at 1900 hours). In the past, only one of three survey regions (Fig. 1) were selected for each "inshore-catch" day and fisheries data collection was restricted to that region. However, because of infrequently used methods (i.e., drag net and surround net), representative samples were sometimes difficult to obtain. Therefore, a broader, boundary-free survey area was used during FY 87 in order to obtain fishermen interviews for some of the rarely used methods.

The FY 87 inshore harvest estimates were calculated by a computer software package known as the Guam Inshore Expansion System (GIES). The GIES utilizes the same formula as described in DAWR's FY 85 project report (Project No. FW-2R-22, Sub-Project F, Study No. F-1, Job No. 2).

RESULTS

During FY 87, the estimated inshore harvest for day, night, and seasonal fishing around Guam was approximately 155.6 m.t. Finfish accounted for approximately 93.6% of the total harvest, or about 145.7 m.t. The finfish catch resulted from a total effort of 300,861.1 person-hours and 249,590.4 gear-hours. Overall, approximately .48 and .58 Kg of fish were taken per person-hour and gear-hour, respectively. Estimated participation, effort, and catch values for each fishing method are shown in Table 1. The values in Table 1 are combined estimates of separate expansions of day, night, and seasonal catch data collections. Tables 2 and 3 present the participation, effort, and catch for day and night fishing for each method.

Hook and line fishing was, by far, the most poplar method accounting for approximately 60% of the total participation. Also, this method yielded the highest estimated catch at 55.9 m.t. or about 35.9% of the total inshore catch. The catch rate for hook and line was about .30 Kg/gear-hour.

Spearfishing yielded the largest harvest for night fishing, at 9,788.2 Kg (Table 3), which accounted for only about 36.8% of the total catch. The mean catch rate for this method was .84 Kg/gear-hour.

Various net fishing methods also contributed to the annual catch estimates. Gill netting was the most popular and most successful net fishing method with 10,358.6 participants (14.7% of the total) and produced about 33.8 m.t. giving a catch rate of 1.23 Kg/gear-hour. Again this year, surround netting yielded the highest mean catch rate of all methods at 2.94 Kg/gear-hour but produced only 6,615 Kg of fish. Cast netting represented the second most popular net method with an estimated 5,996 participants and yielded 8,291.2 Kg. Drag netting also contributed to the estimated catch by yielding approximately 2,740.1 Kg with a large majority being caught at night (2,478 Kg, Table 3).

Surgeonfishes (Family Acanthuridae) comprised 14.6% of the total finfish catch (Table 4). This was attributed to the exceptional catch of unicorn fish (*Naso unicornis*). Other species that comprised a major portion of the finfish catch were jacks (Family Carangidae) at 14.5%, scads (Family Carangidae) at 13.1%, sharks (Family Carcharhinidae) at 10.2%, snappers (Family Lutjanidae) at 8.5%, and mullet (Family Mugilidae) at 8.2% (Table 4).

The seasonal catch of certain juvenile fishes is widely anticipated by local fishers. The FY 87 catch was marked by small numbers of juvenile goatfish (tiao) especially during March and April; juvenile rabbitfish (manahac) during April, May and June; and juvenile jacks (e'e') primarily during July and August. In addition, the catch of atulai (*Selar crumenopthalmus*) occurred from January to September.

In general, the catches of tiao and e'e' are fairly well represented within the expansion estimates given in Tables 1-3. However, the catches of manahac and atulai are not well represented due to the highly sporadic nature of these fisheries which are easily missed by randomly scheduled censuses. Making accurate estimates for such catches requires intensive survey effort during the periods in which these fish are exploited. The seasonal occurrence of juvenile recruitment of *Siganus spinus* and *S. argentius* results in intense fishing over a very short period of time. The effort and catch are therefore determined separately from the inshore catch. Catch and effort data was collected daily during the month-long season and added to the inshore data expansion. Cast nets, gill nets and seines were used to catch an unusually low 2.0 m.t. of juvenile rabbitfish during FY 87.

The sporadic nature of atulai fishing requires a separate analysis from the participation data collected during regular participation surveys. The length of the season was determined by the first participation record and the last. The fishable number of days during that period were determined by the ratio of participated days to the number of survey days each month. This ratio was applied to the number of days in each month within the determined season. The number of fishable days was then multiplied by the average catch rate to determine the catch. This method was applied only to net fishing for atulai because catch estimates by hook and line are included in the annual estimates. The estimated catch of atulai by nets was about 19 m.t. for FY 87.

In addition to finfish, a significant amount of other organisms were taken from the reefs throughout the year. The estimated gaff and hook catch amounted to a very low 1,956.6 Kg and was comprised entirely of octopus which was caught at the rate of .32 Kg/gear-hour. Beyond this, "other methods", such as gleaning, produced an estimated 7.0 m.t. of various crustaceans, gastropods, bivalves, echinoderms and algae with a catch rate of 1.00 Kg/person-hour of fishing effort.

RECOMMENDATION

The addition of a computer system and appropriate software packages have greatly reduced the amount of time needed to compile and analyze Guam's inshore fisheries survey data. Because of this, more effort has been spent to continually upgrade our data collection procedures to ensure statistical reliability. Since the inshore fisheries survey provides information important for management and planning, it is recommended that this job be

continued. Also, provided there is adequate personnel, reinstituting the aerial surveys of uncensused areas around Guam are highly recommended in order to update island-wide participation estimates, as well as including newly accessable areas in the present survey.

Report prepared by: Gerald W. Davis

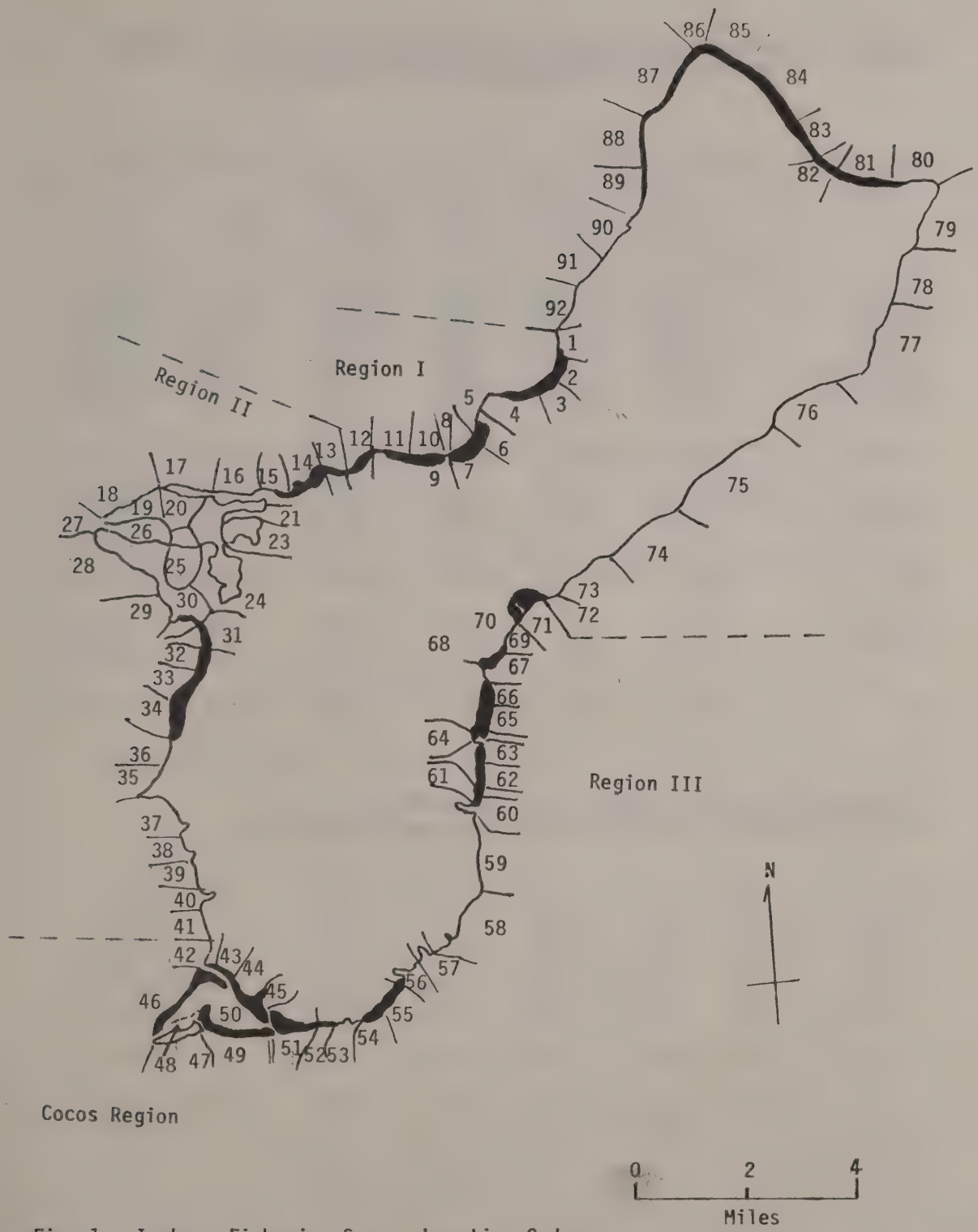

Fig. 1. Inshore Fisheries Survey Location Codes.

Table 1. Combined estimated annual (FY 87) inshore fishing participation, effort, and harvest for day and night data expansions for all methods.

	No. of Persons	No. of Gear Units	No. of Trips	Person-Hours	Gear-Hours	Catch (Kg)
Hook and Line	40750.7	41436.6	25668.4	181993.1	184600.1	55973.0
Cast Net	5996.8	5189.7	4818.4	16941.1	14641.0	8291.2
Gill Net	10358.6	5192.3	5192.3	53765.0	27408.1	33830.9
Surround Net	1258.9	368.3	368.3	7686.5	2253.4	6615.3
Spearfishing	4441.8	4024.3	1206.7	17349.8	15871.3	18088.4
Drag Net	2522.1	417.7	376.9	7527.2	1256.7	2740.1
SubTotal	65328.9	56628.8	37631.0	285262.7	246030.6	125538.9
Octopus Fishing	1058.0	1990.6	439.2	3229.6	6100.8	1956.6
"Other"	1873.8	1873.8	1263.4	7010.6	7010.6	7015.1
SubTotal	68260.7	60493.3	39333.6	295502.9	259142.0	134510.6
Atulai	1391.3	105.4	105.4	10598.4	1059.8	19119.6*
Manahac**	1000	1000	600	5000	2500	2000.0
Total	70652.0	61598.7	40039.0	311101.3	262701.8	155630.2

*Determined by catch/trip x number of trips (181.2 x 105.4).
**Estimated based on last year's participation and the small catches this year.

Table 2. Estimated annual (FY 87) inshore fishing participation, effort, and harvest for daytime period for all fishing methods.

	No. of Persons	No. of Gear Units	No. of Trips	Person-Hours	Gear-Hours	Catch (Kg)
Hook and Line	29309.2	29041.1	19648.7	148820.3	148591.0	51895.7
Cast Net	5804.4	5003.3	4689.1	16471.6	14183.5	8037.1
Gill Net	6547.6	3467.2	3467.2	37582.2	20075.4	26729.0
Surround Net	1238.9	363.3	363.3	7666.5	2248.4	6610.3
Spearfishing	1454.1	1174.2	464.1	5221.7	4308.6	8299.7
Drag Net	65.4	18.0	18.0	176.5	48.5	228.0
SubTotal	44419.6	39067.0	28650.4	215938.8	189455.4	101799.8
Octopus Fishing	999.3	1943.6	425.8	3077.0	5978.7	1925.7
"Others"	659.2	659.2	659.2	2933.3	2933.3	4253.3
Total	46078.1	41669.8	29735.4	221949.1	198367.4	107978.8

Table 3. Estimated annual (FY 87) inshore fishing participation, effort, and harvest for nighttime period for all fishing methods.

	No. of Persons	No. of Gear Units	No. of Trips	Person-Hours	Gear-Hours	Catch (Kg)
Hook and Line	11441.5	12395.5	6019.7	33172.8	36009.1	4077.3
Cast Net	192.4	186.4	129.3	469.5	457.5	254.1
Gill Net	3811.0	1725.1	1725.1	16182.8	7332.7	7101.9
Surround Net	20.0	5.0	5.0	20.0	5.0	5.0
Spearfishing	2987.7	2850.1	742.6	12128.1	11562.7	9788.7
Drag Net	2456.7	399.7	358.9	7350.7	1208.2	2512.1
SubTotal	20909.3	17561.8	8980.6	69323.9	56575.2	23739.1
Octopus Fishing	58.7	47.0	13.4	152.6	122.1	30.9
"Others"	1214.6	1214.6	604.2	4077.3	4077.3	2761.8
Total	22182.6	18823.4	9598.2	73553.8	60774.6	26531.8

Table 4. Species composition of Guam's estimated daytime and nighttime inshore harvest for FY 87. The percentages do not include the seasonal harvest of juvenile rabbitfish (manahac) and bigeye scad (atulai).

Family	% of Finfish Harvest	% of Total Harvest	Weight (Kg)
Fin Fish			
Acanthuridae (surgeonfish)	14.6	13.7	21338.6
Carangidae (jacks)	14.5	13.5	21063.4
Carangidae (scads)	13.1	12.3	19119.6
Carcharhinidae (sharks)	10.2	9.6	14918.2
Lutjanidae (snappers)	8.5	7.9	12342.1
Mugilidae (mullets)	8.2	7.7	11975.2
Mullidae (goatfish)	7.6	7.1	11103.0
Siganidae (rabbitfish)	5.5	5.1	7982.6
Kyphosidae (rudderfish)	4.5	4.2	6567.5
Lethrinidae (emperors)	2.1	1.9	3017.0
Gerreidae (mojarras)	2.0	1.9	2929.1
Holocentridae (squirrelfish)	1.7	1.6	2546.4
Scaridae (parrotfish)	0.9	0.8	1282.9
Labridae (wrasses)	0.5	0.5	708.8
Balistidae (triggerfish)	0.2	0.2	309.3
Other	5.9	5.5	8527.3
SubTotal	100.0		145731.0
Non Fin Fish			
Octopus	---	3.0	4621.7
Lobster	---	3.0	4697.3
Other	---	0.4	580.2
TOTAL	100.0	99.9	155630.2

PROJECT TITLE: Fish Weir Report

PERIOD COVERED: October 1, 1986 to September 30, 1987

During FY 86 and 87, a series of executive orders and legal interpretations made it extremely difficult for fish weir operators to obtain licenses. Consequently, no applications for fish weirs were processed during the past fiscal year. However, at least three of the weirs used during FY 86 continued to operate through all or most of FY 87. Since there was no legal basis for the operation of the weirs, it was impossible to obtain catch information, and therefore impossible to estimate the fish weir catch for FY 87. Since fewer sites were operated during FY 87 than during FY 86, and both catches and catch rates have dropped since FY 84 and never matched the record catch of FY 80, it is unlikely that the FY 87 catch exceeded the 4.4 metric ton catch of FY 86.

Report prepared by Robert F. Myers

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: F
STUDY NO.: F-1
JOB NO.: 3

JOB TITLE: Fisheries Data Processing

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

During FY 87, offshore and inshore fisheries survey data were entered onto computer files and edited for completeness and accuracy. The offshore data base for this fiscal year contains 1806 records and the "inshore-participation" and "inshore-catch" data bases contain 2,127 and 1,733 records, respectively. The primary software packages used for data analysis were the Guam Offshore Expansion System (GOES) for the offshore fisheries survey data and the Guam Inshore Expansion System (GIES) for the inshore fisheries survey data*. No new data was entered into the data base for Job 8, "Studies of Recreationally Important Reef Fish".

BACKGROUND

Guam's Division of Aquatic and Wildlife Resources (DAWR) has been collecting fisheries information for the past ten years and, as a result, an enormous amount of fisheries management data has been accumulated. Computers have been used over the past four years by DAWR to store and analyze this data. DAWR personnel, working closely with the National Marine Fisheries Service, have developed and purchased programs for analyzing the Division's offshore and inshore fisheries survey data.

In FY 83, a program entitled the Guam Offshore Expansion System (GOES) was developed based on the current practices of offshore data analysis and, in FY 85, a Guam Inshore Expansion System (GIES) was completed and tested for errors. Since this time, all data collected for the offshore and inshore fisheries surveys have been analyzed by the use of these two programs.

Job 3, Fisheries Data Processing, has continued to improve over the past fiscal year because of increased computer systems training for DAWR staff biologists and improved hardware and software components. Since its beginning, Job 3 has been jointly funded by the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Western Pacific Regional Fisheries Management Council.

*The "Guam Tournament" module for the GOES could not be used for FY 87 because data collected during the 1987 Guam International Fishing Derby was not complete. Derby totals for FY 87 are estimates based on expanded data. Details are given in the Annual Report for the Guam International Fishing Derby.

OBJECTIVES

The objectives of Job 3 for the past fiscal year were as follows:

1. Computerize the DAWR's offshore and inshore marine fisheries data and transfer the finalized fisheries data files and reports to NMFS personnel in Honolulu, Hawaii for regional application.

2. Provide technical assistance to DAWR staff biologists in the form of efficient statistical analysis and report generation.

3. Continue training of DAWR staff biologists on the proper use of the present computer hardware and software systems.

PROCEDURES

Guam's offshore fisheries survey data is analyzed by a system of computer programs known as the GOES. This programming package is a 5-step system that summarizes, sorts, and statistically expands the survey data to produce monthly and annual catch, effort, and species composition estimates. Two proportionality constants and a "total participation boat count" are calculated and manually input into the expansion module by the user. Reports are generated by the GOES that give a breakdown of the estimated offshore harvest by gear type on a monthly and annual basis. Also, an estimated harvest by species is generated for each gear type with a corresponding percentage of the total catch for that gear type. A second program, known as the "Guam Tournament" module, is an extension of the GOES that separately analyzes the Guam International Fishing Derby (GIFD) data and then adds the results of this analysis directly to the offshore fisheries harvest estimate.

Guam's inshore fisheries survey data is analyzed by a programming package known as the GIES. The GIES is a 4-step system that relies on two sets of survey data to determine an annual inshore estimated harvest. These two sets of data are referred to as "inshore-participation" and inshore-catch". "Inshore-participation" data consists of fishermen and gear counts obtained by staff biologists when driving around the island and making observations on fishing activity within the fringing reef. "Inshore-catch" data is obtained by fishermen-intercept interviews that usually occur within a predetermined survey region. This data consists of a total catch and catch by species for each interview. Because of the apparent differences in participation and catch-per-unit-effort (CPUE) of the various gear types between daytime and nighttime fishing, a fisheries survey is conducted during each of these two time periods and the data are analyzed separately. Also, data is collected during the seasonal harvest of juvenile rabbitfish (*Siganus spp.*) and bigeye scad (*Selar crumenapthalmus*), but, because of the dissimilarities between the seasonal fisheries and the routine inshore fisheries, the two are analyzed separately.

RESULTS

Offshore Fisheries Survey Data Base Management

The DAWR's offshore fisheries survey data for FY 87 were entered onto computer files and edited for completeness and accuracy. The total number of records for the FY 87 offshore data base are 1,806. This brings the total number of historical and current offshore records to 16,596. Since the FY 87 GIFD data were not entered onto the data base, the total number of fishing derby records remains at 1,986.

Based upon the expansion calculated by the GOES and the estimated island-wide offshore harvest for FY 87, including the GIFD results, is about 189 metric tons. For more detailed information, see Job 1, "Offshore Fisheries Survey".

Inshore Fisheries Survey Data Base Management

The FY 87 DAWR inshore fisheries survey data were entered onto two data bases. The "inshore-catch" and the "inshore-participation" data bases for this fiscal year contain 1,733 and 2,127 records, respectively. This brings the total number of historical and current "inshore-catch" records to 20,795 and the "inshore-participation" records to 14,775.

Based upon the expansion calculated by the GIES, the total FY 87 harvest estimate for Guam's inshore fisheries, combining day fishing, night fishing, and seasonal fishing, is approximately 146 metric tons. For more detailed information, see Job 2, "Inshore Fisheries Survey".

Other Fisheries Data Bases

During FY 87, a data base was established for the storage and dissemination reef fish data used for Job 8, "Studies of Recreationally Important Reef Fish". Since Job 8 was inactive during FY 87, the total number of records contained in this data base remains at 1,687.

RECOMMENDATION

Data processing has become a valuable asset to the many research projects currently undertaken at DAWR. Data storage and retrieval, data analysis, and report generation has improved greatly since the installation of a computer system and, because of this, continuation of this job is recommended.

Report prepared by: Robert F. Myers
Data entry and processing by: Gerald Davis, Robert F. Myers and Oscar Mata

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: F
STUDY NO.: F-1
JOB NO.: 8

JOB TITLE: Studies of Recreationally Important Reef Fish

PERIOD COVERED: October 1, 1986 to September 30, 1987

OBJECTIVES

The objective of this study is to research aspects of the biology and life history of recreationally important reef fish on Guam. The findings will be used to ascertain the need for and possible development of management strategies for these fish.

RESULTS

This job was inactive during the period covered because of time constraints and lack of personnel.

RECOMMENDATIONS

This job should be continued when personnel and adequate time become available.

Report prepared by: Gretchen R. Grimm

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT: F
STUDY NO.: 1
JOB NO.: 11

JOB TITLE: Biomass and Stock Assessment

PERIOD COVERED: October 1, 1986 to September 30, 1987

BACKGROUND

Effective management of fisheries resources requires an understanding of the effects of fishing pressure on the stocks of target species as well as an understanding of their population dynamics, life histories, ecology, and limits of distribution within the environment. The harvest of most of Guam's reef fish species is adequately known, however, little quantitative information on their standing stocks is available. Limited surveys have been conducted a number of years ago, but none of these was island-wide in scope, none sampled a complete range of reef zones or habitats, and no attempt has been made to obtain quantitative or adequate qualitative information on populations below the practical limits of scuba diving. As the fishing pressure on Guam's recreational reef fishes continues to increase, it is increasingly necessary to obtain quantitative as well as qualitative information on the standing stocks of these fishes and those they interact with in a representative range of reef zones and habitats and, if possible, in relatively unexploited as well as highly exploited areas.

OBJECTIVE

Assess and monitor the biomass of Guam's important reef fish species within selected sites and reef zones by means of visual transects.

PROCEDURES

Within each reef zone at each site, the following three types of counts of reef fishes are tentatively planned: (1) visual transects consisting of timed 10 minute replicate counts of all roving species within 5 m of the observer, (2) 5 minute replicate counts of all territorial and non-roving species, and (3) counts to the limit of "recognition visibility" of all individuals of "observer shy" or rare species. It should be noted that several new methodologies for visual counts made by scuba divers have appeared in the literature in recent years (eg. Bohnsack and Bannerot 1985); the potential of a number of these is being investigated and, depending on the results of field trials, one or more of these may be selected over one or more of the above methods. Other methods that may yield valuable information beyond the reach of visual transects made by scuba divers are also being investigated. These include the use of a remote video camera (operated by the University of Guam Marine Laboratory; this method may eliminate the bias caused by observer-shy species leaving the area of a scuba diver) and a deep-diving submersible. Both of these methods will enable certain

kinds of counts to be made to the lower depth limit of the species being investigated (Thresher and Colin, 1986).

RESULTS

During FY 86, literature on reef fish community structure and survey methods was reviewed and several study sites around the island were proposed. Transect locations for most of the reef flat and some of the shallow lagoon and seaward reef sites have also been selected and preliminary species lists have been made for some of the habitats within these sites. Unfortunately, resignations within the staff before the end of FY 86 required that this project be postponed until sufficient personnel were hired and trained. During FY 87, activity on this project was limited to two days of preliminary site surveys. It is anticipated that recent and future additions to the Division's fishery staff will make it possible to resume work on this project by mid-1988.

RECOMMENDATIONS

It is recommended that this project remain active at a low level until sufficient personnel are hired and trained to perform the necessary work.

LITERATURE CITED

Bohnsack, J.A., and S.P. Bannerot. 1986. A Stationary Visual Census Technique for Quantitatively Assessing Community Structure of Coral Reef Fishes. NOAA Technical Report NMFS 41, 15 pp.

Thresher, R. E., and P. L. Colin. 1986. Trophic structure, diversity and abundance of fishes of the deep reef (30-300 m) at Enewetak, Marshall Islands. Bull. Mar. Sci. 38(1): 253-272.

Report prepared by: Robert F. Myers

GUAM FISHERIES DEVELOPMENT
PROJECT F-2-D
Federal Aid in Sport Fish Restoration Act

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-2-D-6
SUB-PROJECT NO.: FD-2

JOB TITLE: Construction of Fish Aggregating Devices

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

FY 87 marked the reactivation of the Fish Aggregating Device (FAD) program. The last FAD deployments were made in 1982 and the last FAD on site was lost in April of 1983. The FADs have proven very successful throughout the Pacific as well as on Guam. Unfortunately the cost to construct them does not always support their deployment due to the high frequency of FAD loses. The South Pacific Commission (SPC) has provided information concerning the design of a FAD mooring system that should enhance the longevity of FADs. Guam currently has a permit for 6 site locations for FAD deployments (See Table 1). In preparation for the deployment of 5 FADs in FY 88, 14 surplus Coast Guard Bouys were refinished with welded light mounts. Each bouy is to be fitted with a McDermott navigational light (16 on order). Fourteen 1-ton cement anchors were fabricated and 5 sets of two prefabricated mooring systems are on order from California. The moorings were ordered in pairs to provide a backup mooring for each site. The deployments will be coordinated with a Government owned landing craft capable of carrying all the equipment and a local fishing boat with echosounding equipment aboard (See Table 2 for FAD materials and expense list). The SPC held a FAD conference on construction and deployment in Kiribati in which Guam participated. At the conference, minor changes in the mooring design were presented and mooring preparedness was emphasized (welded shackles, tapered splices, similar metal, etc.). These factors were the focus of attention since the majority of FAD losses throughout the Pacific has been attributed to mooring failures.

FAD Design

The FAD design is still an inverse catenary loop. The deployment of the inverse catenary loop design requires 300 fathom depths or greater and becomes most efficient at 800 fathoms and greater. The proposed design (Figure 1) is as follows: a 400 lb Navy surplus bouy followed by 50 ft. of 3/4" chain (which acts as a counter weight for the bouy). The bottom of the chain has a 3/4" shackle followed by a 3/4" eye and eye swivel followed by another shackle. The last shackle is connected to a predetermined amount of 8 or 12 strand plaited 5/8" nylon rope by a nylite thimble. These thimbles have proven very effective on other FAD systems. In the past a shackle and swivel section was attached between the nylon and polypropylene and it has been documented that this counter weight causes entanglement in the catenary loop. The recommended process requires that the nylon be spliced into 8 or 12 strand plaited 3/4" polypropylene. The polypropylene completes the catenary loop and decends to 100 ft. of 3/4" chain attached to two 1 ton blocks of cement

connected in series. The bottom chain and polypropylene are joined identically to the upper chain and nylon (shackle, swivel, shackle, thimble). The calculation for the lengths of the nylon and polypropylene vary for each FAD depending on the current, depth, and substrate conditions (S.P.C. Handbook No. 24, 1984). The calculations are dependent on how much bottom hardware the designer elects to lift with the polypropylene section. The nylon and polypropylene are recommended to be of 12 strand plaited construction and to be dark in color to limit fishbite.

Proposed Activity for FY'88

1. Fabricate and deploy 5 FADs on Guam (Figure 2).
2. Monitor fishing activity of these sites through existing creel surveys.
3. Make monthly inspections of upper moorings, make repairs and keep records of aggregated fauna.
4 Replace any bouy loses as swiftly as possible, and deploy more bouys if mooring system seems adequate to endure a two year deployment.

Report prepared by: Gerald Davis

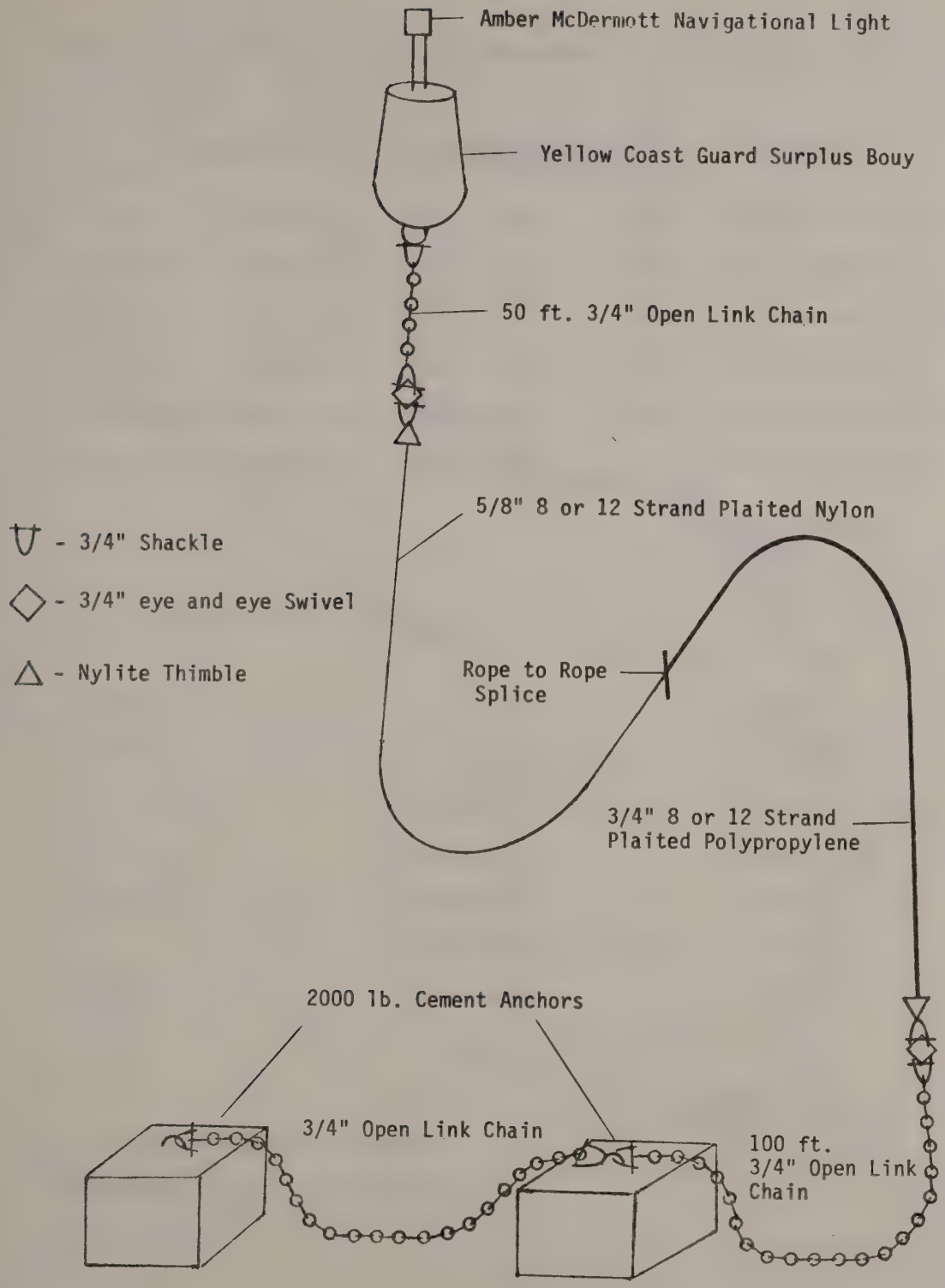
Amber McDermott Navigational Light
Yellow Coast Guard Surplus Bouy
50 ft. 3/4" Open Link Chain
5/8" 8 or 12 Strand Plaited Nylon
- 3/4" Shackle
- 3/4" eye and eye Swivel
- Nylite Thimble
Rope to Rope Splice
3/4" 8 or 12 Strand Plaited Polypropylene
2000 lb. Cement Anchors
3/4" Open Link Chain
100 ft. 3/4" Open Link Chain

Figure 1. Deepwater (800 Fathom) inverse catenary loop FAD design.

Figure 2. Proposed FAD Sites

Table 1. U.S. Navy and U.S. Coast Guard permit approved FAD deployment sites.

Site	Depth (Fathoms Ft.)	Mooring Systems Depth Ft.			Location
		Nylon	Polyprop	Total	
1. (Facpi)	570 (3,420)	1,487	2,702	4,189	13°20.2'N/144°36.4'E
2. (Haputo)	400 (2,400)	875	1,965	2,840	13°37.1'N/144°46.5'E
3. (Cocos)	600 (3,600)	1,561	2,844	4,405	13°14.0'N/144°37.4'E
4. (Ritidian)	500 (3,000)	1,315	2,370	3,685	13°43.1'N/144°53.9'E
5. (Camel Rock)	500 (3,000)	1,315	2,370	3,685	13°32.1'N/144°42.7'E
6. (Apra)	1000 (6,000)	(Alternate Site)			13°30.2'N/144°35.8'E

Table 2. FAD material and expense list.

Quantity	Item	Cost
14 (2000 lb)	Cement Block Anchors	$ 4,000.00
14 (Tear Drop)	Navy Surplus Mooring Buoys	7,000.00
10 (5 sets of 2)	Mooring Systems	26,860.00*
(10 systems)	Shipping Cost	2,564.64**
16	McDermott Navigational Light	2,740.66**
(5 systems)	Cost to Deploy	3,000.00**

* Money encumbered but not released.

** Money not encumbered but cost confined.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam **PROJECT NO.:** F-2-D-7

JOB TITLE: Development of Small Boat Launching Facililties

PERIOD COVERED: October 1, 1986 to September 30, 1987

OBJECTIVES

Repair existing structure and extent existing structure ten feet.

RESULTS

This project was delegated to the Government of Guam Department of Public Works (DPW) to solicit for and retain an Architectural and Engineering (A&E) firm to identify the areas in need of repair, design the necessary modification and extension plans and carry out construction.

At the close of the fiscal year the bidding process had been completed however, a contractor had not been selected. Only one A&E firm submitted a bid which was deemed unacceptable by DPW. The DPW attributes the lack of response by A&E firms to be related to the relative low profit for this project caused by the high cost of mobilization.

RECOMMENDATIONS

This project should be continued until construction on the pier is completed. The objectives of this project should be evaluated to consider replacement rather than rehabilitation and extension of the existing pier. Reconstruction may be a viable alternative to repair in terms of longevity of the pier itself and securing an A&E firm. Replacement would require a larger budget, increasing the profit margin which may attract A&E firms to compete for the project.

Report prepared by: Gretchen R. Grimm

AQUACULTURE
Funding Source: National Marine FisherieService
(P.L. 88-309)
Government of Guam

PROJECT TITLE: Development of Tropical Polyculture Fish Farming

PERIOD COVERED: October 1, 1986 through September 30, 1987.

OVERVIEW

During FY 87, the Division of Aquatic and Wildlife Resources (DAWR) continued to work primarily with the Thai catfish, *Pangasius sutchi*. Forty-four catfish brooders continued to be fed an improved diet to promote their sexual maturation. During the expected breeding season of the second year of life, the female brooders developed white to cream colored immature eggs and the male brooders produced milt.

In addition, DAWR personnel provided a limited amount of technical assistance to the aquaculture community and the general public of Guam (Table 1). However, the primary role of providing technical and field assistance to local aquaculture farmers has been assumed by the University of Guam Extension Service.

Table 1. People given technical aquaculture assistance from October 1, 1986 to September 30, 1987*

NAME	LOCATION	AFFILIATION	INTEREST
Iain Gault	Agana Heights	Private	Tilapia & Guppies
Biology/Science Teachers	Agana	DOA	Algae & Aquatic
Norman Crisostomo	Mangilao	Private	Guppies
Howard Hatton	Windward Hills	Private	Mosquito Fish
Pat Wood	-	Private	General Aquaculture
Angel C. Chargulaf	Barrigada	Private	Tilapia & Aquatic Plants
Melvin Fish	Toto	Harvest Christian Academy	Catfish
David Flores	Talofofo	Private	Catfish & Tilapia
Roland Solivio	Piti	Private	Catfish & Tilapia
Paul Techaira	Mangilao	Private	Guppies
John Campus	Mangilao	Private	Guppies
Patrick Cruz	Mangilao	Private	Guppies
Mr. Dorrity	Singapore	Operational Supplies Consultants	Importation of Post Larvae & Milkfish Fry from the Philippines

*In addition to those listed, numerous local aquaculturists contacted the DAWR during the fiscal year for technical assistance covering a wide range of topics.

ARTIFICIAL REPRODUCTION OF THE THAI CATFISH, *PANGASIUS SUTCHI*

Forty-four catfish, *Pangasius sutchi*, brooders continued to be held in an 0.1 hectare pond at Inarajan, Guam. The catfish continued to receive a specially formulated diet to enhance sexual maturation. The male brooders had abundant milt during the breeding season, which appears to be from April to September. The female brooders in their second year of life did not reach sexual maturity during the 1987 breeding season. No artificial reproduction trials were conducted since the eggs did not reach full oogenesis.

OBJECTIVES

1. To obtain oogenesis and egg release in the Thai catfish, *Pangasius sutchi*, at Guam.

2. To develop a viable methodology for artificially reproducing *P. sutchi* and for rearing its hatchlings to the fingerling stage at Guam.

PROCEDURES

A 0.1 hectare, triangular-shaped pond with a screened six-inch inflow pipe was used for the project. The water depth in the pond ranged from .3 to 1.3 meters with a mean depth of .75 meters. The pond used for the project was small and protected by large trees on one side, which helped keep the water surface calm and smooth. The pond preparation and initial stocking of the brooders was outlined in the FY 1986 report (Kruckenberg, 1986). From October 1986 to March 1987, the pond was flushed during the first and third week of each month by manipulating the stand pipe and filling with a submersible pump attached to a six-inch pipe. The pond flushing was discontinued from April to September because of low water levels in the Ajayan River. Following each flushing, the pond was filled to its normal level as soon as practical. The pond level was maintained by the periodic additions of water, if needed.

Five catfish were sampled every month to determine the feeding rate. Starting in July, approximately fifty percent of the brooders were sampled every three weeks to monitor gonadal development and milt production along with their weights. Each brooder was examined for the state of reproductive maturation by using a combination of bending the fish and gently rubbing its abdomen near the vent, and/or by physically trying to suck out some of the eggs using a plastic catheter.

A special diet was formulated and fed to the brooders five times a week. The feeding rate was based on 4% of their total biomass from October to January and 6% from February to September. Between October and March, the diet consisted of soybeans (36%), chum tuna (36%), yellow corn meal (6.75%), dark red winter wheat (6.75%), whole barley (6.75%), rice (6.75%), *Spirulina* (.18%), cod liver oil (.26%), Vitamin E (.18%) and pelbon-feed grade bentonite (.38%). In April and June, 1987, sea salt (1%) and calcium phosphate (2%) were added to the diet, respectively. The other ingredients in the diet were adjusted accordingly. At the beginning of August, linseed oil and sunflower seed oil were both added to the diet at the one percent level and the percent of tuna chum in the diet was increased from thirty-five percent to fifty percent (Table 2). This was done so that the dry weight ingredients of the diet were more balanced with the wet. By making this correction in the diet, the protein levels may have been slightly reduced.

To prepare the feed, the size of the soybeans were reduced in a blender, steamed for 10 minutes and heated in the oven at 105°C for 50 minutes. During the steaming, the moisture content was increased by 11%. After a complete drying of the ground soybeans, all the grains were finely ground in a Magic Mill III flour mill. After the grains were milled, the dry ingredients were weighed on a triple beam balance, put into a metal basin for mixing and placed in plastic bag. The freshly processed feed was placed into a styrofoam chest with blue ice to keep the temperature down during transport to the pond. Just prior to fish feeding, the cod liver oil and Vitamin E were mixed in with the freshly thawed tuna. The flour and tuna were combined, mixed, and kneaded to a dough-like consistency. The feed was formed into small balls and fed to the fish usually during the mid-afternoon. Cloud cover, wind, air temperature, water temperature, water color, water surface, water level, fish activity, and other general observations were made at every feeding which occurred between 1300 and 1700 hrs. Records of the maximum and minimum water temperatures between feedings were also kept.

Starting in January, 1987, weekly water quality analysis was initiated to monitor and establish normal levels for the parameters of alkalinity, carbon dioxide, free chlorine, total chlorine, calcium hardness, total hardness, dissolved oxygen and pH using the Hach methods.

RESULTS

The diet for the brooders was specially formulated for their growth and sexual maturation (Table 2). The feeding rate was increased from four percent to six percent of the total body weight because initially the brooders did not show an increase in weight. With the additional amount of food, the brooders still did not grow. Next, sea salt and calcium phosphate were added to the diet and the fish grew. Linseed and sunflower oil were added to the diet from August to September 1987, to assist in their growth and the maturation of brooder eggs (Cho, Cowey and Watanabe, 1985). The mean weight of the fish increased from 1.18 Kg during the period of October to December, 1986, to 1.46 Kg for the period of July to September 1987.

Five brooders were sampled on a monthly basis to determine the feeding rate and observe the fish. During October and November 1986, all of the male brooders had milt present. From December 1986 to February 1987, no milt was observed in the male brooders. Some milt was observed in the males during the March sample. From April to September, all of the observed males had milt. The female brooders had their first observable eggs in July 1987, during their second year of life. The eggs varied in color from white to light yellow.

At three-week intervals, twenty-one to twenty-seven brooders were observed from July to September, 1987. We could not look at every brooder because the pond could not be completely drained and filled back up due to low water levels in the Ajayan River. All of the males observed had milt and a red vent. Each sample had some female fish with eggs that were removed by sucking with the catheter. The color of the eggs varied from white to cream. Some individual eggs had a very slight yellowish, greenish, or yellow-orange color. The brooders seemed to exhibit stronger sexual differences than had been observed in the past. The males had a dark red pore for releasing the milt and a majority had a white to slightly yellow-orange ridge before the vent. The females had a definite ventral opening for the eggs to pass out for fertilization. Of the brooders sampled, 61% were male and 39% were female. Based on the mean weights for the brooders, the weight of the females ranged from .25 - .43 Kg more than that of the males. The weights of the brooders ranged from .75 - 2.50 Kg with a mean of 1.39 Kg.

Water quality (Table 3) and temperature data provided us with information about the conditions in the pond . In April, chlorine was indicated in the water analysis. This may have been due to chloride ions partially dissolved into the water as a result of the addition of sea salt to the diet. The other water quality parameters remained relatively constant. Air temperature at the time of daily feeding ranged from 24.0 - 34.5°C with a mean of 29.9°C, and water temperature ranged from 26.0 - 35.0°C with a mean of 31.4°C, with the coolest temperatures occurring from November to February. Water temperature between feeding ranged from 25.0 to 36.5°C with a mean of 30.6°C.

The predominate color of the water during the project was milky brown green. Since the water level fluctuated in the pond, new freshwater was added as soon as possible after the level was found to be low. Ocassionally, during the feeding period, some catfish would be seen surfacing for air or swimming near the water surface. Filamentous green algae and the"water weed", *Hydrilla verticullata*, were present in the pond during the year and had to be removed on a weekly basis. Turbidity increased slightly after the addition of calcium phosphate to the diet beginning in June 1984. Tilapia, *Sarotherodon* sp., were present in the pond during the year and were observed grazing on the aquatic plants. The presence of the tilapia, and weekly removal of aquatic plants, kept the pond open throughout the year.

DISCUSSION

During the expected breeding season (June to September) the brooders developed immature eggs that varied in color from white to cream white, faint yellow green or rarely, to yellow orange. This variability in color indicates that the female brooders are in the process of maturing and may need a third year to develop viable eggs (Potaros and Sitasit, 1976). In the latter stages of egg development, injections of human chorionic gonadotropin and carp pituitary may be needed to complete the egg maturation and induce ovulation.

The maturation of the female brooders may have been adversely affected by a lack of pond flushing after March. This was an unfortunate consequence of low water levels in the Ajayan River. Periodic flushings may partially rid a pond of a possible "repressive factor" (Swingle 1956) which appears to be a hormone-like excretion or secretion of riverine fishes that prevents or retards their reproduction when placed in ponds. If such a substance has been present in the water, it may have had a serious impact on the reproductive development of the brooders.

RECOMMENDATIONS

1. The pond water should be flushed twice a month when the water levels in the Ajayan River reach normal levels.

2. The diet should be improved by adding ethoxyquin, a multi-vitamin mineral complex, and raising the cod liver oil in the diet to the 1% level.

3. The tilapia should be periodically removed because they could directly compete with the brooders for food.

4. Since it may take another year for females to reach full maturity, this project should be continued through at least the next breeding season. Throughout this period the *P. sutchi* should be left in the pond and checked periodically for successful oogenesis, particularly during July and August.

5. Injections of human chorionic gonadotropin and carp pituitary may be required to complete oogenesis.

6. If the females fail to mature fully by the end of the third year, a flow-through riverine enclosure should be used, or the project should be discontinued.

LITERATURE CITED

Cho, C.Y., C.B. Cowey, and T. Watanabe. 1985. Finfish nutrition in Asia: methodological approaches to research and development. Ottawa, Ont., IDRC. 154p.

Kruckenberg, W.L. 1986. Annual Report Fiscal Year 1986. Aquatic & Wildlife Resources, Department of Agriculture, Government of Guam.

Pataros, M. and P. Sitasit. 1976. Induced Spawning of *Pangasius sutchi* (Fowler). Technical Paper. No. 15. Freshwater Fisheries Division, Department of Fisheries, Bangkok, Thailand. 14 p.

Swingle, H.S. 1956. A Repressive Factor Controlling Reproduction in Fishes. Proceedings of the Eighth Pacific Science Congress. Oceanography and Zoology. National Research Council of the Philippines, University of the Philippines, Diliman, Quezon City. Vol. III A. p. 865-871.

Report prepared by: Wayne Kruckenberg

Table 2. Composition of Diets Fed to Pangasius sutchi in Brooder Pond at Inarajan, Guam.

Item	% of the Diet	GRAMS IN THE DIET 10/15/86	11/11/86	12/5/86	1/2/87	2/2/87	3/3/87	% of the Diet	4/7/87	5/5/87	% of the Diet	6/4/87	7/6/87	% of the Diet	8/4/87	9/1/87
Soy (a)	36.00	760.3	622.8	900.0	820.8	763.2	1044.0	36.00	1163.0	1371.0	35.00	1072.4	1275.0	20.00	818.4	765.6
Tuna (chum) (b)	36.00	760.3	622.8	900.0	820.8	763.2	1044.0	36.00	1163.0	1371.0	35.00	1072.4	1275.0	50.00	2046.0	1914.0
Yellow Corn Meal (c)	6.75	142.6	116.8	168.8	153.9	143.1	195.8	6.50	210.0	247.6	6.50	199.2	236.8	6.00	245.5	229.7
Dark Red Winter Wheat (d)	6.75	142.6	116.8	168.8	153.9	143.1	195.8	6.50	210.0	247.6	6.50	199.2	236.8	6.00	245.5	229.7
Whole Barley (e)	6.75	142.6	116.8	168.8	153.9	143.1	195.8	6.50	210.0	247.6	6.50	199.2	236.8	6.00	245.5	229.7
Rice (f)	6.75	142.6	116.8	168.8	153.9	143.1	195.8	6.50	210.0	247.6	6.50	199.2	236.8	6.00	245.5	229.7
Spirulina (g)	.18	3.8	3.1	4.5	4.1	3.8	5.2	.18	5.7	6.9	.18	5.5	6.6	.18	7.4	6.9
Cod Liver Oil (h)	.26	5.4	4.5	6.5	6.0	5.5	7.5	.26	8.3	10.0	.26	8.0	9.5	.26	10.7	10.0
Vitamin E (i)	.18	3.8	3.1	4.3	4.1	3.8	5.1	.18	5.6	7.0	.18	5.5	6.6	.18	7.4	6.6
Pelbon (j)	.38	8.0	6.5	9.5	8.6	8.1	11.0	.38	12.2	14.5	.38	11.6	13.8	.38	15.6	14.6
Sea Salt (k)								1.00	32.2	38.2	1.00	30.6	36.4	1.00	40.9	38.3
Calcium Phosphate (l)											2.00	61.2	72.9	2.00	81.8	76.6
Linseed Oil (m)														1.00	40.9	38.3
Sunflower Seed Oil (n)														1.00	40.9	38.3
Total Grams	100.00	2112.0	1730.0	2500.0	2280.0	2120.0	2900.00	100.00	3230.0	3809.0	100.00	3064.0	3643.0	100.00	4092.0	3828.0

(a) In middle of May, 1987, switched from Dairyland Seed Co., Inc., Westbend, WI 53095 to Arrowhead Mills, Inc., Box 866 Hereford, Texas 79045.
(b) Fishermans Coop, Agana, Guam 96910.
(c) Yellow Corn Meal of Food Service Division, The Quaker Oats Company through the Hawaiian Flour Mills, 703 N. Nimitz HWY, Honolulu, Hawaii 96817.
(d) Hawaiian Flour Mills, Honolulu Hawaii 96817.
(e) Carnation Company, Los Angeles, CA 90036.
(f) In middle of May, 1987 switched from Koda's Kokuho Rose Brown Rice, Nishimoto Trading Co., Ltd., 1111 Mateo Street, Los Angeles, CA 90021 to Long Grain Tiger Brand Rice, Thailand packed by J.J.J. Enterprises, P.O. Box 6066, Tamuning, Guam 96911.
(g) The Earthrise Company, P.O. Box 1196, San Rafael, CA 94915.
(h) Rexall Corporation, St. Louis, Mo. 63115.
(i) Natures Bounty, Inc., Bohemia, New York 11716.
(j) American Colloid Company, Skokie, Illinois 60077.
(k) Paul De Souza's Co., Banning, CA 92220.
(l) EM Science, Cherry Hill, N.J. 08034.
(m) Hain Pure Food Co., Inc., Los Angeles, CA 90061.
(n) Beatrice/Hunt-Wesson, Inc., P.O. Box 4800, Fullerton, CA 92634.

Table 3. Monthly Water Quality Data for Thai Catfish, (Pangasius sutchi), Brooder Pond at Inarajan, Guam from January 16 to September 30, 1987.

Month No. of Samples	Jan 3	Feb 4	Mar 4	Apr 5	May 4	Jun 4	Jul 6	Aug 4	Sep 5	Mean 4.33	Range 3-6
Alkalinity	90.00	68.75	93.75	67.00	98.75	115.00	64.20	63.75	42.00	78.13	20.00-140.00
Carbon Dioxide	.80	3.25	2.00	0.00	1.50	4.00	5.30	13.00	6.80	4.07	00.00 - 20.00
Free Chlorine	0.00	0.00	0.00	.01	.06	.06	.04	.05	.06	.03	00.00 - 00.10
Total Chlorine	0.00	0.00	0.00	.01	.06	.06	.04	.05	.06	.03	00.00 - 00.10
Hardness-Calcium	33.33	33.75	27.50	24.00	27.50	18.75	40.00	40.00	23.00	29.76	15.00-100.00
Total	103.30	97.50	87.50	67.00	78.75	75.00	91.70	107.50	76.00	87.14	55.00-130.00
Dissolved Oxygen	11.67	9.75	9.00	10.70	10.75	7.10	6.50	6.50	8.80	8.97	3.00 - 17.00
Ph	6.75	6.89	7.00	8.14	7.50	7.10	6.80	6.80	6.70	7.08	6.50 - 9.00

GUAM WILDLIFE INVESTIGATIONS
PROJECT FW-2R-24
Federal Aid in Wildlife Restoration Acts

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: W-1
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Determination of Current Population Size and Distribution of Guam Deer

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Recreational hunting appeared to have greater appeal to island sportsmen as hunting license sales increased 21% during FY 1987 and totaled 525 licenses. An estimated 321 deer hunters spent 4,943 days hunting deer and harvested 54 animals during FY 1987. Ninety-one percent of the reporting hunters indicated they hunted deer and achieved hunter success of 16.7%. Hunter success and harvest during FY 1987 was slightly higher than the 14.1% success and 41 deer harvest reported in FY 1986. It required less effort to harvest a deer in FY 1987, 91.5 days/deer, a decrease of 25% over the FY 1986 level. A special either-sex hunt was held at Pati Point on Andersen Air Force Base (AAFB) during January and February, 1987. Seventy tags were issued and hunters spent 154 hunter-days during the hunt and harvested 31 deer (hunter success of 44%). The special hunts provided the best opportunity to harvest a deer as just 5.0 hunter-days were spent per deer harvested. The most popular deer hunting areas on island were Northwest Field (NWF), Naval Communication Area Master Station (NAVCAMS), and bow areas on AAFB. Deer hunters also reported hunting the Cotal (Tarzan Falls) and Anao Territorial Conservation Reserves and private property. Population trend data obtained with spotlight counts indicated a non-significant ($P=0.35$) decrease in deer numbers at AAFB, a non-significant increase in deer numbers at Naval Magazine ($P=0.12$) and a non-significant decrease in water buffalo numbers at the Naval Magazine ($P>0.20$).

BACKGROUND

The Guam deer has been under investigation by the Division of Aquatic & Wildlife Resources since 1961. Its distribution, population trends and biology have been described by Wheeler (1979). Deer hunting statistics have been compiled since 1968 through hunter reporting procedures. The regular deer season is October 1 through December 31 with a bag limit of one antlered deer (buck only) per season per license holder exclusive of any special hunt harvest.

OBJECTIVES

To determine the current size and distribution of the deer population of Guam and to monitor population trends.

PROCEDURES

1. Continue spotlight counts on AAFB at 21 counts per year, 4 per month in May - July and one per month in other months.

   a. Record number, age, sex and group composition.

   b. Statistically analyze count data and compare with past data to discern population trends.

2. Continue monthly spotlight counts on Naval Magazine with periodic spotlight counts in other areas.

3. Collect hunting statistics via a hunter questionnaire. Analyze hunting statistics for changes in hunter kill, effort, and hunting location.

4. Collect biological data from carcasses killed during regular season and special hunts or from incidental sources such as road kills or confiscated animals.

RESULTS

Deer Hunting Statistics

License sales increased 21.2% during FY 1987 with 525 licenses sold throughout the year (Table 1). One hundred license holders were mailed a harvest questionnaire and responses were obtained from 49 persons (49%). Sixty-seven percent of the respondents indicated they had hunted during FY 1987. Based on that percentage, an estimated 353 persons legally hunted game during the year.

Deer hunting remained a popular pastime for island sportsmen with 91% of the responding hunters indicating they hunted deer during the FY 1987 season (Table 1). Hunter success at 16.7% increased slightly from the 14.1% reported in FY 1986. The reported harvest of 5 deer came from Northwest Field (4) and Bolanos Conservation Reserve (1). All were reported taken by shotgun. An average of 15.4 days were spent hunting deer by the reporting hunters, slightly less than the 17.1-day average reported in FY 1986.

Estimates of total hunter participation, effort, and harvest were derived from information provided on the hunter questionnaires. Based on questionnaire data, an estimated 321 hunters spent 4943 days hunting and harvested 54 deer, an 18% decrease in participation, 32% increase in harvest, and a 2% decrease in effort over FY 1986 levels. Deer hunters expended an average of 91.5 days effort for each deer harvested in FY 1987, a considerable improvement from the 122.6 hunter-days expended per deer harvested in FY 1986.

The military bases on the northern end of the island remained the preferred areas to hunt deer. Northwest Field and bow areas on AAFB were hunted by 40% and 7% of the responding hunters. The Navy bases of NAVCAMS and NAVFAC were hunted by 27% and 3% of the reporting hunters. Territorial Conservation Reserves at Cotal (Tarzan Falls) and Anao were each hunted by 3% of reporting hunters and private property was reported as hunted by 17%.

The shotgun remained the weapon of choice for deer hunting with 77% of the responding hunters reporting they used the shotgun for deer hunting. The bow was

the next most popular weapon used by 20% of the reporting hunters. Rifles and handguns were less popular and used by 7% each.

An accurate record of hunter effort and take from military installation is summarized in Table 2. NAVCAMS received heavy hunting pressure this past season with total hunting effort during the 3-month season at 1128 hunter-sorties, an increase of 34% from the 842 hunter-sorties reported in FY 1986. Four deer were harvested in FY 1987, an increase from the 2 recorded in FY 1986. The effort required to harvest a deer at NAVCAMS decreased from FY 1986 levels with a total of 282 hunter-sorties expended per deer taken, an improvement of 33% over the 421 hunter-sorties expended per deer harvested in FY 1986.

Military exercises limited hunting to a single weekend at Northwest Field in October 1986 and consequently Northwest Field received less hunting pressure than NAVCAMS during FY 1987. Eighteen deer were harvested during the season with 890 hunter-sorties and 563 hunter-days spent hunting. Northwest Field was by far the most productive area to hunt deer during the regular season with 49.4 hunter-sorties expended per deer harvested (31.3 hunter-days/deer). In contrast, 282 days were expended per deer harvested on NAVCAMS and hunters responding to a harvest questionnaire reported expending an average of 91.5 days effort for each deer harvested in FY 1987.

A special either-sex hunt was held at Pati Point during January and February, 1987. Forty tags were issued for January and 30 tags were issued for February. A total of 154 hunter-days was spent hunting deer in the special hunts. Hunter success was high at 44% as 31 deer were harvested, 13 bucks and 18 does (Table 2). Special hunts appear to provide the best opportunity for hunters to bag a deer as the 5.0 hunter-days expended per deer harvested was far lower than the 31 days required at Northwest Field or the 282 sorties required at NAVCAMS.

Spotlight Count Trends

Population trends of the Pati Point and Naval Magazine deer herd were monitored via spotlight counts on AAFB (21) and NAVMAG (12) during FY 1987. The average number of deer seen per count decreased slightly (Mann-Whitney U-Test, $U = 245.5$, $n_1=20$, $n_2=21$, $P=0.35$, NSD) on AAFB from 111.9 in FY 1986 to 109.2 in FY 1987 (Table 3). Numbers seen during the best 3 months of the year for sighting deer, May-July, decreased significantly over FY 1986 levels (Mann-Whitney U-Test, $U = 120.5$, $n_1=12$, $n_2=12$, $P=0.005$). The average number of deer seen per count decreased from 139.4 in May-July, 1986 to 113.3 in May-July, 1987. The largest count increased from 170 (204 deer per 10 km) in 1986 to 181 (270 deer per 10 km).

Deer numbers on Naval Magazine increased for the second year in a row as the average number of deer seen per count increased from 6.5 deer in FY 1986 to 9.0 deer in FY 1987 (Table 4). The increase was not statistically significant (Mann Whitney U-Test, $U=98.5$, $n_1=12$, $n_2=11$, $P=0.12$) but does suggest that the population may be rebuilding from the decline recorded in FY 1983-1985. Eighteen deer (7.7 deer per 10 km) was the largest count recorded during FY 1987, a slight decrease from the 19 (8.6 deer per 10 km) deer recorded in FY 1986.

Feral Asiatic Water Buffalo

Sightings of water buffalo (carabao) were made during the spotlight counts at NAVMAG (Table 4). The average number of water buffalo seen per count decreased slightly from 37.7 in FY 1986 to 36.4 in FY 1987, a nonsignificant decrease (Mann-Whitney U-Test, U=73.5, P>0.20). The largest number seen on a monthly count decreased from 78 in FY 1986 to 68 in FY 1987. Water buffalo numbers appear to have changed little during FY 1987.

RECOMMENDATION

Continue spotlight counts at present intensity at NAVMAG and AAFB. Collect biological data from carcasses as available.

LITERATURE CITED

Aquatic and Wildlife Resources Division. 1986. Job Progress Reports. Federal Aid to Fish and Wildlife Restoration, Department of Agriculture, Government of Guam, Agana, Guam.

Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.H. Freeman and Co., San Francisco. 859 pp.

Wheeler, M.E. 1979. The biology of the Guam deer. Aquatic and Wildlife Resources Division Technical Report No. 3, Department of Agriculture, Government of Guam, Agana, Guam. 53 pp.

Report prepared by: Paul J. Conry

Table 1. Island-wide deer hunting statistics for FY 1987 as based on hunter responses to a harvest questionnaire.

a.	Total license sales for all game species	525
b.	Number of questionnaires sent out	100
c.	Number of hunter questionnaires returned	49
d.	Percent of queried license buyers that responded	49.0%
e.	Number of reporting license buyers (49) that hunted any species	33
f.	Percent of license buyers that hunted any species	67.3%
g.	Estimated total number of legal hunters	353
h.	Number of reporting hunters (33) that hunted deer	30
i.	Percent of reporting hunters that hunted deer	90.9%
j.	Number of deer taken by 30 reporting deer hunters	5
k.	Hunter success	16.7%
l.	Estimated total number of legal deer hunters	321
m.	Estimated total legal deer take	54
n.	Hunter days expended by 29 reporting deer hunters	447
o.	Average number of days spent per reporting deer hunter	15.4
p.	Estimated total number of days spent hunting deer	4943
q.	Number of days spent hunting per deer taken	91.5

Table 2. Hunter effort and deer take based on official hunter logs from Naval Communication Area Master Station (NAVCAMS) and Northwest Field during FY 1987.

	Oct	Nov	Dec	Jan	Feb	Total	Effort/take
NAVCAMS							
No. hunter sorties	475	395	258			1128	282.0
Deer taken	3	0	1			4	--
Northwest Field							
No. hunter sorties	82	405	403			890	49.4
No. hunter days	48	260	255			563	31.3
Deer taken	4	8	6			18	--
Bow Areas on AAFB							
No. hunter days	176	126	67			369	NA
Deer taken	0	0	0			0	--
Special Hunt on AAFB							
No. hunter days				90	64	154	5.0
Deer taken				17	14	31	--

Table 3. Composition of deer herd seen during spotlight counts at Andersen Air Force Base, during FY 1987.

		1986			1987								Summary Statistics			
	COUNT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL	AVE.	SD	CV-%
Unclassed buck	1	2	7	4	0	1	2	0	1	1	1	2	4	44	2.1	1.9	93
	2								2	0	2						
	3								0	1	6						
	4								3	1	4						
	Ave.	2.0	7.0	4.0	0.0	1.0	2.0	0.0	1.5	0.8	3.3	2.0	4.0				
Spike	1	1	0	2	2	1	3	2	3	0	1	0	0	25	1.2	1.2	102
	2								4	0	0						
	3								2	1	1						
	4								2	0	0						
	Ave.	1.0	0.0	2.0	2.0	1.0	3.0	2.0	2.8	0.3	0.5	0.0	0.0				
2pt	1	1	1	0	0	0	0	1	1	0	0	0	0	13	0.6	0.9	149
	2								4	0	1						
	3								1	1	1						
	4								0	0	1						
	Ave.	1.0	1.0	0.0	0.0	0.0	0.0	1.0	1.5	0.3	0.8	0.0	0.0				
3pt	1	8	5	4	9	12	1	1	7	1	3	7	5	83	4.0	3.2	81
	2								1	0	4						
	3								1	2	4						
	4								2	1	5						
	Ave.	8.0	5.0	4.0	9.0	12.0	1.0	1.0	2.8	1.0	4.0	7.0	5.0				
4pt	1	0	0	0	0	0	0	0	0	0	0	1	0	2	0.1	0.3	316
	2								0	0	0						
	3								0	0	1						
	4								0	0	0						
	Ave.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.0	0.0				
Doe	1	46	51	39	60	57	51	53	45	53	53	54	43	1109	52.8	11.9	23
	2								60	33	74						
	3								72	49	73						
	4								28	53	62						
	Ave.	46.0	51.0	39.0	60.0	57.0	51.0	53.0	51.3	47.0	65.5	54.0	43.0				
Yearling	1	13	7	13	8	12	5	7	5	9	14	10	12	197	9.4	4.0	42
	2								5	7	15						
	3								6	11	16						
	4								6	2	14						
	Ave.	13.0	7.0	13.0	8.0	12.0	5.0	7.0	5.5	7.3	14.8	10.0	12.0				
Fawn	1	4	4	7	4	9	6	3	1	5	6	1	7	110	5.2	2.5	48
	2								8	9	4						
	3								5	8	9						
	4								2	4	4						
	Ave.	4.0	4.0	7.0	4.0	9.0	6.0	3.0	4.0	6.5	5.8	1.0	7.0				
Unclassed-deer	1	22	28	21	47	34	24	40	52	34	36	22	22	711	33.9	12.6	37
	2								26	18	43						
	3								30	40	70						
	4								24	36	42						
	Ave.	22.0	28.0	21.0	47.0	34.0	24.0	40.0	33.0	32.0	47.8	22.0	22.0				
Total	1	97	103	90	130	126	92	107	115	103	114	97	93	2294	109.2	25.2	23
	2								110	67	143						
	3								117	113	181						
	4								67	97	132						
	Ave.	97.0	103.0	90.0	130.0	126.0	92.0	107.0	102.3	95.0	142.5	97.0	93.0				
Miles (Ave.)		5.1	4.8	4.7	4.8	4.4	4.8	4.6	4.4	4.3	4.2	4.1	4.5				
Km (Ave.)		8.2	7.7	7.5	7.7	7.0	7.7	7.4	7.0	6.9	6.7	6.6	7.2				
Deer/10 mi (Ave.)		190.2	214.6	191.5	270.8	286.4	191.7	232.6	232.4	220.9	339.3	236.6	206.7		234.5	44.7	19
Deer/10 km (Ave.)		118.9	134.1	119.7	169.3	179.0	119.8	145.4	145.2	138.1	212.1	147.9	129.2		146.5	28.0	19
Bucks-in-velvet	1	3	2	2	0	0	0	0	1	2	0	0	2	26	1.2	1.4	111
	2								3	0	1						
	3								0	0	4						
	4								1	4	1						
	Ave.	3.0	2.0	2.0	0.0	0.0	0.0	0.0	1.3	1.5	1.5	0.0	2.0				

Table 4. Composition of deer herd seen during spotlight counts at Naval Magazine, Guam during FY 1987.

	1986			1987								Summary Statistics			
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL	AVE.	SD	CV-%
Unclassed buck	1	0	1	3	2	0	0	1	0	0	0	2	10	0.8	1.03	124
Spike	1	0	1	0	1	0	0	0	0	0	0	0	3	0.3	0.45	181
2pt	0	0	0	0	1	0	1	0	0	0	0	0	2	0.2	0.39	234
3pt	1	2	0	2	4	2	2	0	0	0	1	1	15	1.3	1.22	97
4pt	0	0	0	0	0	0	0	0	0	0	0	0	0			
Doe	0	1	2	9	5	2	2	1	1	4	1	8	36	3.0	2.92	97
Yearling	1	0	1	0	0	0	0	0	1	0	1	1	5	0.4	0.51	124
Fawn	0	0	2	2	0	0	0	1	1	0	0	1	7	0.6	0.79	136
Unclassed deer	1	3	3	0	1	8	1	3	3	1	1	5	30	2.5	2.24	89
Total	5	6	10	16	14	12	6	6	6	5	4	18	108	9.0	4.84	54
Miles traveled	14.9	15.0	14.1	15.0	13.9	16.7	15.0	14.8	14.9	14.4	16.8	14.6	180.1	15.0		
Km traveled	24.0	24.1	22.7	24.1	22.4	26.9	24.1	23.8	24.0	23.2	27.0	23.5	289.8	24.2		
Deer/10 mi	3.4	4.0	7.1	10.7	10.1	7.2	4.0	4.1	4.0	3.5	2.4	12.3	72.6	6.1	3.35	55
Deer/10 km	2.1	2.5	4.4	6.6	6.3	4.5	2.5	2.5	2.5	2.2	1.5	7.7	45.1	3.8	2.08	55
Water Buffalo	48	35	36	35	29	8	43	54	41	23	68	17	437.0	36.4	16.32	45
Buffalo/10 mi	32.2	23.3	25.5	23.3	20.9	4.8	28.7	36.5	27.5	16.0	40.5	11.6	290.8	24.2	10.12	42
Buffalo/10 km	20.0	14.5	15.9	14.5	13.0	3.0	17.8	22.7	17.1	9.9	25.2	7.2	180.7	15.1	6.29	42

FINAL REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: W-1
STUDY NO.: 1
JOB NO.: 3

JOB TITLE: Determination of Diet Quality of Guam Deer

PERIOD COVERED: October 1, 1986 to September 30, 1987

OBJECTIVES

1. To investigate differences in diet nutritional quality between the Pati Point, Andersen Air Force Base (AAFB) and Naval Magazine (NAVMAG) deer herds and between the water buffalo and deer populations on NAVMAG.

2. To establish baseline DAPA index values for the AAFB and NAVMAG deer and carabao herds both seasonally and between years.

3. To investigate seasonal variation in the nutrient quality of key forage plants.

4. To investigate variation in the nutrient quality of individual deer diets.

PROCEDURES

Deer pellets, and *Pennisetum polystachyon* grass samples were collected on a monthly basis from Andersen Air Force Base (AAFB) and Naval Magazine (NAVMAG), areas supporting the two major deer herds on the island. Composite samples of deer pellets composed of 3 pellets from each of 15 different fresh groups, a water buffalo fecal sample composed of about 10 ml of feces from each of 15 different fresh droppings and approximately 100 gms of fresh grass were collected monthly from each area.

Fecal and rumen samples were also collected from deer carcasses examined at hunter check stations and from deer confiscated from poachers or road kills. Body measurements were taken, and a kidney fat and marrow fat content indices of body condition calculated for each carcass, when possible.

The Wildlife Habitat Management Services, Department of Forestry and Range Management, Washington State University, was contracted to perform DAPA (diaminopimelic acid) content analysis on the fecal samples and nutrient analysis for crude protein, gross energy, and Calcium/Phosphorous content on the grass and rumen samples.

RESULTS

This project was completed and a final report written in FY 1986. A copy of the final progress report is included in the Division's FY 1986 Annual Report. Results of this study may be written up for publication in a professional journal at some time in the future.

Report prepared by: Paul J. Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: W-1
STUDY NO.: 2
JOB NO.: 1

JOB TITLE: Preparation of a Status Report on Wild Pigs

PERIOD COVERED: October 1, 1986 to September 30, 1987

OBJECTIVES

To prepare a status report on wild pigs to be used in planning future work.

RESULTS

Progress was made toward completion of this job during Segment 24. A draft of the report was completed and it is now being reviewed by other members of the Division.

RECOMMENDATION

Finalize and publish the technical report during Segment 25.

Report prepared by: Paul J. Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: W-1
STUDY NO.: 2
JOB NO.: 2

JOB TITLE: Population Size and Distribution of Wild Pigs on Guam

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Pig hunting remained popular with Guam hunters during FY 1987. An estimated 299 pig hunters spent 6,548 days hunting pigs and harvested an estimated 822 pigs, a decrease of 11% in hunter participation, 25% in hunter effort, and 35% in harvest from FY 1986 levels. Hunter success increased from 68% in FY 1986 to 75% this year, however, the average take per successful hunter decreased from 5.6 pigs in FY 1986 to 3.67 pigs in FY 1987. The effort expended per pig harvested increased from 6.8 days/pig in FY 1986 to 8.0 days per pig harvested. Northwest Field and Naval Communications Area Master Station (NAVCAMS) were the most popular pig hunting areas on Guam, with Anao and Cotal (Tarzan Falls) Territorial Conservation Reserves and other private lands also identified as areas hunted. Official hunter logs documented effort, harvest, and effort per harvest of 2,251 hunter-sorties, harvest of 155 pigs, and effort/harvest of 14.5 hunter-sorties per pig at NAVCAMS; 1,521 sorties, 1,028.5 hunter days, harvest of 169 pigs, and effort/harvest of 6.1 days per pig at Northwest Field; and effort of 699 days, harvest of 101 pigs, and effort/harvest of 6.9 days per pig in bow areas of AAFB.

BACKGROUND

The wild pig *(Sus scrofa)* is one of Guam's most popular game mammals. The wild pigs on Guam descend from stock introduced by the Spanish during their 300-year rule on the island. Wild pigs are found island-wide, though appear to be most numerous in the limestone forests of the north and the ravine forests of southern Guam. Depredation on agricultural crops is often a problem, especially for farmers in southern Guam during the dry season. Fieldwork on pigs in the past has been concentrated on military lands. There is a need to assess pig populations in other areas of the island, particularly in the south, where pigs may be under-harvested and where crop damage by pigs is a common complaint. Hunting Regulations promulgated on March 28, 1987 extended the hunting season for pigs to year-round throughout the island with bag limits of 2 pigs per day and 40 per season.

OBJECTIVES

To monitor trends in pig population size and hunter participation and harvest.

PROCEDURES

1. Record pig sightings during deer spotlight counts, and observations of pigs or pig sign during other fieldwork.

2. Monitor hunter participation and harvest during the legal hunting season.

RESULTS

License sales increased 21.2% during FY 1987 with 525 licenses sold throughout the year. One hundred license holders were mailed a harvest questionnaire and responses were obtained from 49 persons (49%). Sixty-seven percent of the respondents indicated they had hunted during FY 1987. Based on that percentage, an estimated 353 persons legally hunted game during the year.

Ninety-five percent of the Guam hunters reported they hunted pigs during the FY 1987 season (Table 1). Hunter success was high with 75% of the reporting hunters harvesting at least one pig in FY 1987. The average take per hunter decreased from 3.8 pigs in FY 1986 to 2.75 pigs in FY 1987. Likewise, the average take per successful hunter declined from 5.6 pigs in FY 1986 to 3.67 pigs in FY 1987. Pig hunters spent less time in the field this past year, an average of 22 days per hunter versus 26 days per hunter in FY 1986. More effort was expended to harvest a pig in FY 1987, 8.0 hunter-days per pig versus 6.8 hunter-days in FY 1986.

Estimates of hunter participation, effort, and harvest were derived from hunter questionnaires. An estimated 299 pig hunters spent 6,548 days hunting pigs and harvested 822 pigs in FY 1987. Those estimates are consistently lower than the estimates of 335 hunters spending 8,710 days and harvesting 1,273 pigs in FY 1986. In summary, FY 1987 had a decrease in hunter participation (11%), hunter effort (25%), and hunter harvest (35%).

The shotgun remained the weapon of choice for most pig hunters and was used by 75% of reporting hunters. Archery hunting was next in popularity with 21% of the reporting hunters hunting with bows. Handguns and rifles were used by fewer hunters, 14% and 4% respectively.

The military bases on the northern end of the island were once again the most popular areas to hunt with Northwest Field, NAVCAMS, and bow areas on AAFB reported as the most frequently hunted areas. Private property and the Cotal (Tarzan Falls) and Anao Territorial Conservation reserves were also hunted.

An accurate record of hunting activity and harvest was recorded during mandatory check in and out procedures at NAVCAMS and Andersen Air Force Base and is reported in Table 2. With the increase in the seasons, hunting pressure and take increased during FY 1987. On NAVCAMS, hunter effort increased to 2,251 hunter-sorties (estimated 1,521 eight-hr hunter-days based on a ratio of 1.48 sorties per hunter-day as derived from AAFB data) with a harvest of 155 pigs versus hunter effort of 1,275 hunter-sorties and a harvest of 98 pigs in FY 1986. It required slightly more effort to harvest a pig in FY 1987; 14.5 hunter-days in FY 1987 versus 13.0 hunter-days in FY 1986. Hunter participation and harvest were high on Northwest Field and in the bow areas on Andersen Air Force Base. At Northwest Field, 1,521 hunter-sorties (1,028.5 hunter days) were expended to harvest 169 pigs with an effort of 6.1 days per pig harvested. Bow areas on AAFB were also heavily hunted and yielded a good harvest, 699 hunter days were

expended with a harvest of 101 pigs and effort of 6.9 days per pig harvested. No comparative data were available from Northwest Field for FY 1986.

RECOMMENDATIONS

Continue to monitor the annual pig harvest and hunter participation.

LITERATURE CITED

Aquatic and Wildlife Resources Division. 1986. Job Progress Report - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Report prepared by: Paul J. Conry

Table 1. Pig hunting statistics for FY 1987 as based on hunter responses to a harvest questionnaire.

a.	Total license sales for all game species	525
b.	Number of questionnaires sent out	100
c.	Number of questionnaires returned	49
d.	Percent of queried license buyers that responded	49.0%
e.	Number of reporting hunter (49) that hunted any species	33
f.	Percent of license buyers that hunted	67.3%
g.	Estimated total number of legal hunters	353
h.	Number of reporting hunters that hunted pigs	28
i.	Percent of reporting hunters that hunted pigs	84.8%
j.	Number of successful pig hunters	21
k.	Hunter success	75.0%
l.	Number of pigs taken by the 28 reporting pig hunters	77
m.	Average number of pigs taken per pig hunter	2.75
n.	Average number of pigs taken per successful hunter	3.67
o.	Estimated total number of legal pig hunters	299
p.	Estimated total legal pig take	822
q.	Number of hunter days expended by 28 reporting pig hunters	612
r.	Average number of days spent per reporting pig hunter	21.9
s.	Estimated total number of days spent hunting pigs	6548
t.	Days of hunting effort per pig taken	8.0

Table 2. Hunter effort and pig take based on official hunter logs from Naval Communication Station and Northwest Field during FY 1987.

	NAVCAMS		AAFB Northwest Field			AAFB Archery	
Month/Year	No. hunter-sorties	Pig take	No. hunter-sorties	No. 8-hr. hunter days	Pig take	No. 8-hr. hunter days	Pig take
1986							
October	475	33	82	48	12	176	9
November	395	23	405	260	39	126	24
December	258	20	403	255	35	67	2
1987							
January	291	14	145	118	20	36	6
February	238	18	135	103.5	15	26	1
March	79	7	186	145	17	139	39
April	0	0	40	22.5	7	42	2
May	88	3	30	16.5	7	13	0
June	94	10	51	28	7	42	8
July	152	10	24	16.5	3	16	9
Aug	138	16	20	15.5	7	16	1
September	43	1	0	0	0	0	0
Total	2251	155	1521	1028.5	169	699	101
Effort/ pig taken	14.5	--	9.0	6.1	--	6.9	--

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: W-1
STUDY NO.: 2
JOB NO.: 4

JOB TITLE: Wild Pig Biology and Natural History

PERIOD COVERED: October 1, 1986 to September 30, 1987

OBJECTIVES

To obtain basic biological information on wild pigs through the examination of hunter-killed pig carcasses.

BACKGROUND

The wild pig (*Sus scrofa*) is one of Guam's most popular game mammals. In order to improve management of this wildlife resource, the Division began to collect biological information from hunter-killed pig carcasses during Segment 21 under Job W-2-2. This activity continued during Segment 22 & 23, when it was developed as a separate Job.

PROCEDURES

1. Conduct Hunter Checking Stations at selected areas and examine hunter-killed pig carcasses.

2. Collect basic biological information from carcasses pertaining to reproductive biology, growth rates, body condition, and food habits.

RESULTS

This project was inactive during Segment 24.

Report prepared by: Paul J. Conry

FINAL REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: W-2
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Preparation of a Status Report on Philippine Turtle-Doves

PERIOD COVERED: October 1, 1986 to September 30, 1987

OBJECTIVES

To prepare a status report on Philippine Turtle-Doves for use in planning future work.

RESULTS

This project was completed during Segment 24 and published as the Division of Aquatic and Wildlife Resources Technical Report No. 6, Ecology of the Philippine Turtle-Dove on Guam. This report is now available for distribution.

Report prepared by: Paul J. Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: W-2
STUDY NO.: 1
JOB NO.: 2

JOB TITLE: Population Numbers and Distribution of Philippine Turtle-Doves

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Because of a continuing decline in numbers and extremely poor nesting success caused by snake predation, the Philippine Turtle-Dove hunting season was closed as of March 28, 1987. Dove numbers continued to decline in northern Guam as reflected in the significant declines on stationary counts at Northwest Field (NWF, $P<0.001$) and roadside counts at the Conventional Weapons Storage Area (CWA, $P<0.005$) on Andersen Air Force Base (AAFB). An average of 22.5 doves were recorded per count at NWF, down 36% from FY 1986 levels and an average of 24.0 turtle-doves were recorded per count in the CWA, down 17% from FY 1986 levels. Turtle-doves were observed on all 23 spring game bird surveys conducted during June 1987 and were distributed throughout the island. Doves were found in highest numbers at Cocos Island, Ija, Barrigada Hill, Navy Golf Course in Barrigada, Mt. Santa Rosa, and Northwest Field. Increases in numbers occurred at Northwest Field, Mt. Santa Rosa, Barrigada Hill, and Ija. A large decrease in numbers occurred at Navy Golf Course in Barrigada. The native Mariana Fruit-Dove (*Ptilinopus roseicapilla)* and White-throated Ground-Dove (*Gallicolumba xanthonura)* were not recorded on either survey route during FY 1987.

BACKGROUND

The Philippine Turtle-Dove (*Streptopelia bitorquata*) was introduced to Guam by the Spanish during their early colonization of the region, circa 1771 (Baker 1951) and has been regulated as a game bird since as early as 1903 (Conry 1987). Up through the early 1960s, the turtle-dove was very common and found in large numbers in both northern and southern Guam. By the late 1960s, dove populations in southern and central Guam began to decline and stabilized at low levels. Populations in northern Guam crashed in the late 1970s and early 1980s. Turtle-doves are now found in appreciable numbers only in prime dove habitat on Northwest Field on Andersen Air Force Base and at moderate numbers in selected areas of central and southern Guam. Predation by the brown tree snake (*Boiga irregularis*) is the major cause of nest loss (Conry 1987) and the brown tree snake is thought to be responsible for the population decline. A large population still remains on snake-free Cocos Island. Because of the decline in numbers and the extremely poor nesting success, the Department of Agriculture officially closed the turtle-dove hunting season as of March 28, 1987. The season will be reopened if nesting success improves and numbers recover to a level that can support recreational hunting.

OBJECTIVES

1. To determine present population levels and distribution, and monitor population trends.

2. To investigate nesting success and causes of nest failures.

PROCEDURES

Call-count and roadside-count surveys were conducted at Northwest Field (NWF) and the Conventional Weapons Storage Area (CWA) on Andersen Air Force Base (AAFB). Both surveys were conducted twice monthly in early morning. The call-count survey consisted of counting the number and species of doves seen or heard during a 5-minute period at 10 stations in NWF plus the number of doves seen enroute between stations. The roadside-count survey at CWA involved counting the number of Philippine Turtle-Doves seen while driving at 25 km per hour along an established 32 km route. The Philippine Turtle-Dove is also censused in a twice weekly roadside-count survey conducted in 3 areas of northern Guam (Job W-1-3). Presence and numbers of turtle-doves were recorded during spring game bird surveys conducted island-wide during June. The surveys consisted of 5-minute station counts at up to 10 stations per route with the number of birds seen or heard recorded at each station. Twenty-three routes were surveyed in 1987. Results are summarized as average number of birds recorded per station.

RESULTS

Changes in Regulations: Philippine Turtle-Dove Season Closed

Because of a continuing decline in numbers and extremely poor nesting success caused by snake predation, the Department of Agriculture closed the hunting season for Philippine Turtle-Dove. Regulations closing the season were officially adopted on March 28th, 1987 along with other changes in the hunting regulations. The season will remain closed for an indefinite period until nesting success improves and numbers recover to a level that can support recreational hunting. This will likely only occur after snake numbers have declined on the island due to natural causes or after initiation of control measures.

Population Surveys

Call count surveys and roadside counts were continued at NWF and the Conventional Weapons Magazine (CWA) on Andersen Air Force Base (Table 1). Dove numbers continued their downward trend of the past 4 years at both locations. Counts averaged 22.5 birds/count at NWF during 1987, a 36% decline from the 35.1 birds/count average during FY 1986. The decline in numbers was statistically significant at the P=0.05 level (Mann Whitney U-Test, U =510, P<0.001; Sokal and Rohlf 1981).

FY 1987 roadside counts in the CWA were significantly lower (Mann Whitney U-Test, U =409, P<0.005; Sokal and Rohlf 1981) than counts in FY 1987. The average count declined 17% from 29.4 birds/count in FY 1986 to 24.0 birds/count in FY 1987.

The native Mariana Fruit-Dove (*Ptilinopus roseicapilla)* and White-throated Ground-Dove (*Gallicolumba xanthonura)* were not recorded on either survey during FY 1987. The fruit-dove has not been seen on either survey since FY 1985 and the ground-dove was last recorded on these surveys in FY 1986. One ground-dove was sighted by DAWR staff on Route 15 in the vicinity of Andersen South on June 30, 1987 and a second sighting of a male ground-dove was made in the Manengon area on July 9, 1987. No fruit-dove sightings were reported for Guam during FY 1987.

Spring Game Bird Surveys

Turtle-doves were recorded on all 23 spring game bird counts conducted during 1987 and were distributed throughout the island (Table 2). Cocos Island had the highest counts with an average of 6.3 birds recorded per station. Northwest Field, Mt. Santa Rosa, Navy Golf Course in Barrigada, Barrigada Hill and Ija also had relatively high station counts. Average number of birds observed per station increased from 1986 to 1987 at Northwest Field, Mt. Santa Rosa, Barrigada Hill, and Ija. A large decrease in the average number of birds observed per station occurred at the Navy Golf Course in Barrigada. Most other locations surveyed showed little change between years and had relatively low numbers of turtle-doves.

RECOMMENDATION

1. Continue call count and roadside count surveys in northern Guam to monitor distribution, relative abundance and population trends of the Philippine Turtle-Dove.

2. Keep Philippine Turtle-Dove hunting season closed until nesting success improves and the population recovers (Conry in press).

LITERATURE CITED

Aquatic and Wildlife Resources Division. 1986. Job Progress Report. Federal Aid to Fish and Wildlife Restoration, Dept. of Agriculture, Government of Guam, Agana, Guam.

Baker, R.H. 1951. The avifauna of Micronesia, its origin, evolution, and distribution. University of Kansas Pub. 3(1):1-359.

Conry, P. J. 1987. Ecology of the Philippine Turtle-Dove on Guam. Tech. Report No. 6. Division of Aquatic & Wildlife Resources, Dept. of Agriculture, Mangilao.

Conry, P.J. In Press. High nest predation by brown tree snakes on Guam. Condor.

Report prepared by Paul J. Conry

Table 1. Results of Philippine Turtle-Dove surveys at Northwest Field (NWF) and the Conventional Weapons Area (CWA) on Andersen Air Force Base, Guam during FY 1987.

	NWF Surveys			CWA Surveys		
Month	1	2	Average	1	2	Average
1986						
October	33	18	25.5	22	15	18.5
November	26	21	23.5	27	22	24.5
December	20	15	17.5	25	14	19.5
1987						
January	18	24	21.0	10	17	13.5
February	12	19	15.5	23	19	21.0
March	19	19	19.0	22	50	36.0
April	19	30	24.5	18	19	18.5
May	24	24	24.0	29	19	24.0
June	25	17	21.0	40	33	36.5
July	13	29	21.0	28	34	31.0
August	26	36	31.0	29		29.0
September	28	36	32.0	19	19	19.0
Average count			22.5			24.0

Table. 2. Numbers of Philippine Turtle-Doves observed per count and average number of birds per station as detected in spring game bird surveys at various locations on Guam during June 1987. Values in the trend column are the difference between the average station count between years.

Survey Location	No. Stations	No. Doves Observed	1987 Ave./ station	Trend in Ave. 85-87	Trend in Ave. 86-87
Tarague	10	6	0.60		-0.10
CWA	10	6	0.60		-0.20
NWF	10	25	2.50	-0.80	1.10
NAVCAMS	10	6	0.60	0.40	0.60
Capitol Improvement Road	10	1	0.10	-0.20	-0.50
MT. Santa Rosa	9	12	1.33	0.43	0.93
Y Sengsong Road	10	2	0.20	0.00	-0.20
Two Lovers Point	10	6	0.60	0.50	0.10
Andy South	10	3	0.30	0.00	-0.10
Navy Golf Course Barrigada	10	19	1.90	-0.80	-1.10
Barrigada Hill	7	14	2.00	2.00	1.30
Toto Pipeline	8	2	0.25	-0.25	-0.05
Nimitz Hill	10	2	0.20	0.17	-0.40
Reserve Craft Beach Road	4	1	0.25	-1.75	-0.25
Orote Point	6	3	0.50	-1.70	-0.80
Pulantat	9	8	0.89	0.09	0.09
Cross Island Rd.	10	2	0.20	0.00	0.10
NAVMAG	10	1	0.10	-0.80	-0.50
Umatac	10	1	0.10	0.10	-0.20
Dandan	10	1	0.10	-0.10	0.00
Ija	5	5	1.00	0.70	1.00
Merizo	6	4	0.67	0.17	-0.03
Cocos Island	7	44	6.30	2.50	0.40

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 1

JOB TITLE: Preparation of a Status Report on Black Francolin

PERIOD COVERED: October 1, 1986 to September 30, 1987

OBJECTIVES

To prepare a status report on Black Francolin to be used in planning future work.

RESULTS

This project was inactive during Segment 24.

Report prepared by: Paul J. Conry

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 2

JOB TITLE: Population Size and Distribution of Black Francolin on Guam

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Black Francolin were legally hunted during the months of January and July, 1987. An estimated 72 hunters spent 310 days hunting and harvested 360 birds, expending 0.86 days hunting per bird taken. Dandan, Talofofo, and Cross Island Road areas were reported as areas hunted. Black Francolin were found on 12 of 23 spring game bird surveys conducted throughout the island during 1987. Francolin occurred on all surveys south of Route 4, with the exception of the Reserve Craft Beach route and on Cocos Island. In addition, a small population was detected north of Route 4 in shrub-grass habitat in the Barrigada Hill area. The Pulantat area appeared to have the largest population of birds with an average of 7.67 birds/station detected during the 1987 survey. Nimitz Hill, Cross Island Road, Naval Magazine, Umatac, Dandan, Ija, and Merizo survey routes had moderate to high numbers of birds with an average count of 3-6 birds/station recorded during these surveys. Francolin populations are well established throughout southern Guam and appear able to sustain the current levels of recreational hunting.

BACKGROUND

In 1961, 171 Black Francolin *(Francolinus francolinus)* were introduced in southern Guam as part of the Foreign Game Bird Introduction Program of the U.S. Fish and Wildlife Service. Surveys conducted in 1980 indicated the population was adequately established in most parts of southern Guam to open a hunting season. Regulations were promulgated to open a 1-month season in December 1981 with a 4 bird daily limit and a 20 bird season limit. Francolin populations continued to increase from 1980-1982 but hunting pressure remained low, probably because of the unfamiliarity of the hunting public with the sporting qualities of the bird. With the bird population consisently increasing and little hunting pressure, the francolin season and bag limits were further liberalized in FY 1983 to a 2 month-split season, 1 month in January and 1 month in July, and the bag limit was increased to 5 birds per day with no season limit. Francolin hunting has increased in popularity and Guam hunters are successfully harvesting birds during the open seasons. Regulations implemented in FY 1983 remain in effect to date with hunter participation and adherence to game laws monitored by spot checks by Division biologists and conservation officers.

OBJECTIVES

To determine current relative abundance and current distribution of Black Francolin on Guam and monitor population trends and hunter harvest.

PROCEDURES

1. Conduct annual island-wide spring game bird surveys (station counts) to monitor distribution and status of francolin throughout the island (Fig. 1).

2. Conduct twice weekly station-count surveys during May-June to monitor pre-hunting season status of francolin population in Dandan, Inarajan.

3. Monitor hunter harvest via an annual harvest questionnaire. Collect information on hunter participation, effort, harvest, and areas hunted.

RESULTS

Francolin Hunting Statistics

License sales increased 21.2% during FY 1987 with 525 licenses sold throughout the year. One hundred license holders were mailed a harvest questionnaire and responses were obtained from 22 persons (22%). Eighty-two percent of the respondents indicated they had hunted during FY 1987. Based on that percentage, an estimated 429 persons legally hunted game during the year. Hunters were asked to provide information on the amount of effort expended hunting, game harvested, and locations hunted. The following harvest statistics are based on the responses of 22 hunters that completed the questionnaire.

In FY 1987, 17% of the Guam hunters reported they hunted francolin, 6% during the January season, 11% during the July season, and 17% overall (Table 1). All reporting francolin hunters were successful. The hunters that responded to our questionnaire took an average of 6.0 birds in January, 4.5 birds in July and 5.0 birds overall.

Francolin hunters expended an average of 7.0, 3.0, and 4.3 days hunting in January, July, and over the entire season, respectively. The hunting effort expended per bird harvested was 1.2 days/bird in January, 0.67 days/bird in July, and 0.86 days/bird overall.

Estimates of total hunter participation, effort, and harvest were based on hunter questionnaires. In FY 1987, an estimated 72 hunters spent 310 hunter days and harvested 360 birds over the entire season. In contrast, 56 hunters spent 414 days hunting and harvested 297 birds in FY 1986. The hunter statistics for FY 1987 indicated an increase in hunter participation of 28%, a decrease in hunter effort of 25%, and an increase in hunter harvest of 21% over FY 1986 levels.

Dandan, Talofofo and Cross Island Road were identified as areas hunted this past year. Hunters were not queried about their hunting habits. No one reported they hunted with a bird dog.

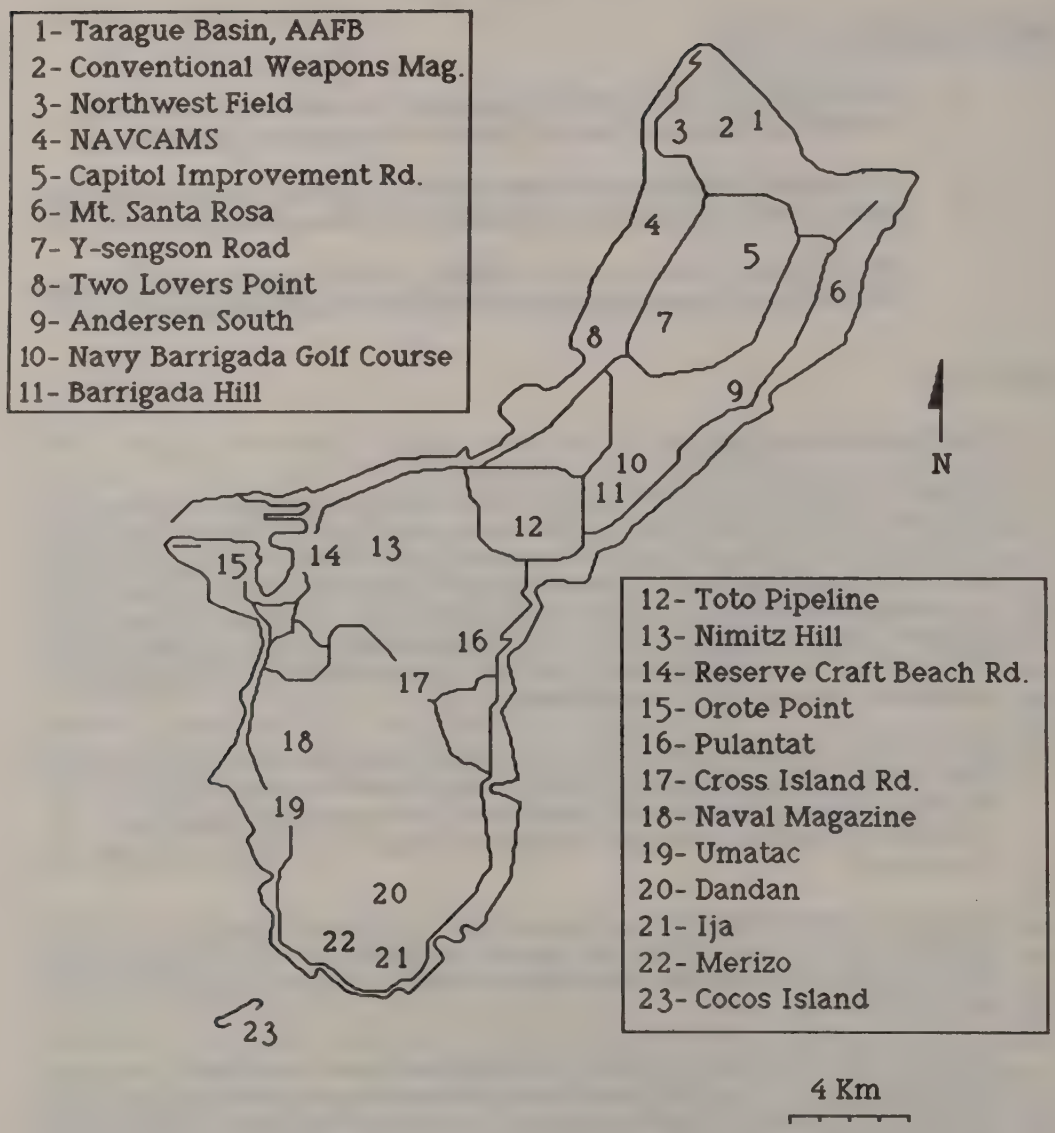

Figure 1. Map showing location of spring game bird surveys conducted on Guam during June, 1987.

The estimated total hunter participation, effort, and harvest seemed far higher than actual francolin hunting activity. The inflated estimates are probably related to the fact that unsuccessful hunters or those that did not participate don't report their activities. The fact that statistics such as average take and average days spent hunting are based on the responses of just a few persons, the accuracy of harvest and participation estimates are questionable. Because such a small percentage of the hunting population hunts francolin (approximately 15%), it appears that a 100% sample rather than a random sample of 100 hunters would yield better data for BLFR harvest and participation estimates.

Spring Game Bird Surveys

Black Francolin were detected on 12 of 23 spring game bird surveys (Fig. 1) conducted during 6 June 1987 (Table 2). Francolin were found on most surveys south of Route 4, with the exception of the Reserve Craft Beach route and Cocos Island, and on the Barrigada Hill and Navy Barrigada Golf Course surveys north of Route 4. A small population has apparently become established in the shrub-grass habitat in the vicinity of the Naval Air Station, Agana and the antenna fields in the Barrigada area. The Pulantat area had the highest station counts with an average of 7.67 birds/station which was higher than the 6.8 birds/station average in FY 1986 but below the 9.9 birds/station average in FY 1985. The Nimitz Hill, Cross Island Road, Umatac, Dandan, Ija, and Merizo survey routes also had high average station counts. The average number of birds detected per station increased on 4 of the survey routes between 1986 and 1987 and decreased on 7 of the routes. The largest increases in station averages between years occurred in the Nimitz Hill, Navy Golf Course in Barrigada and Pulantat areas and the largest decreases occurred in the Cross Island Road and Reserve Craft Beach areas. Francolin populations remain well established and stable throughout southern Guam and a small population has become established in shrub-grass habitat in north-central Guam.

RECOMMENDATIONS

1. Continue to monitor francolin population status, distribution, and hunter harvest.

2. Increase the response rate of annual hunter questionnaire.

LITERATURE CITED

Aquatic and Wildlife Resources Division. 1986. Job Progress Reports - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Sokal, R.R. and F.J. Rohlf. 1981. Biometry. W.H. Freeman Company. San Francisco. 859 pp.

Report prepared by Paul J. Conry

Table 1. Black Francolin (BLFR) harvest statistics for FY 1987.

	Jan 87	Jul 87	Total
a. Total license sales for year			525
b. Hunter questionnaires mailed out			100
c. Number of hunter questionnaires returned			22
d. Percent of license buyers reporting			22.0%
e. Number of respondents (22) that hunted any species			18
f. Percent of license buyers that hunted FY 87			81.8%
g. Estimated total number of legal hunters FY 87			429
h. Number of reporting hunters that hunted BLFR	1	2	3
i. Percent of reporting hunters that hunted BLFR	5.6%	11.1%	16.7%
j. Number of successful BLFR hunters	1	2	3
k. Hunter success	100.0%	100.0%	100.0%
l. Number of BLFR taken by reporting hunters	6	9	15
m. Average number of BLFR taken per hunter	6.0	4.5	5.0
n. Average number of BLFR taken per successful hunter	6.0	4.5	5.0
o. Estimated total number of legal BLFR hunters	24	48	72
p. Estimated total legal BLFR harvest	144	216	360
q. Reported number of days spent hunting	7	6	13
r. Average number of days spent hunting	7.0	3.0	4.3
s. Estimated total number of days spent hunting	168	144	310
t. Number of days spent hunting per BLFR taken	1.2	0.67	0.86
u. Number of BLFR taken per day hunting	0.86	1.5	1.16

Table 2. Numbers of Black Francolin (BLFR) observed per count and average number of birds per station as detected in spring game bird surveys at various locations on Guam during June 1987. Values in the trend column are the difference between the average station count between years.

Survey Location	No. Stations	No. Birds Observed	1987 Ave./ station	Trend in Average 85-87	Trend in Average 86-87
Tarague	10	0	0.00		0.0
CWA	10	0	0.00		0.0
NWF	10	0	0.00	0.0	0.0
NAVCAMS	10	0	0.00	0.0	0.0
Capitol Improvement Road	10	0	0.00	0.0	0.0
MT. Santa Rosa	9	0	0.00	0.0	0.0
Y Sengsong Road	10	0	0.00	0.0	0.0
Two Lovers Point	10	0	0.00	0.0	0.0
Andy South	10	0	0.00	0.0	0.0
Navy Golf Course Barrigada	10	9	0.90	0.7	0.9
Barrigada Hill	7	2	0.29	-2.0	0.0
Toto Pipeline	8	0	0.00	0.0	0.0
Nimitz Hill	10	47	4.70	1.6	1.3
Reserve Craft Beach Road	4	0	0.00	0.0	-0.8
Orote Point	6	15	2.50	0.7	0.2
Pulantat	9	69	7.67	-2.2	0.9
Cross Island Rd.	10	45	4.50	0.9	-1.3
NAVMAG	10	33	3.30	-0.5	-0.4
Umatac	10	45	4.50	-0.1	-0.4
Dandan	10	42	4.20	0.8	-0.2
Ija	5	27	5.40	0.8	-0.2
Merizo	6	30	5.00	-0.8	-0.2
Cocos Island	7	0	0.00	0.0	0.0

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT N0.: FW-2R-24
SUB-PROJECT: W-4
STUDY NO.: 1
JOB NO.: 3

JOB TITLE: Survey and inventory of native birds on Guam and Northern Mariana Islands

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

This job was inactive during this segment. All native bird survey work was done under Endangered Species Project E-1-2, Job 1-5-1, which ran concurrently.

Report prepared by: Robert E. Beck, Jr.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-24
SUB-PROJECT NO.: W-5
STUDY NO.: 1
JOB NO.: 2

JOB TITLE: The Current Status, Distribution and Natural History for Marianas Fruit Bats

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

This job was inactive during this segment. All fruit bat work was done under Endangered Species Project E-1-2, Job 1-6-2, which ran concurrently.

Report prepared by: Gary J. Wiles

GUAM ENDANGERED SPECIES INVESTIGATIONS
PROJECT E-1-1-2
Section 6-Endangered Species Act of 1973

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 4
JOB NO.: 1

JOB TITLE: Captive Breeding Endangered Native Birds

PERIOD COVERED: October 1, 1987 to September 30, 1987

SUMMARY

The DAWR rail breeding facility was enlarged to a capacity of 50 birds. During the year, 8 Guam Rails were hatched and 5 died. There is a total of 21 rails in captivity on Guam and approximately 80 rails and 49 Micronesian Kingfishers in captivity at mainland U.S. zoos.

BACKGROUND

Since the creation in 1960 of the Guam Division of Aquatic and Wildlife Resources (DAWR), census data from roadside counts, station counts, and transect counts have documented the reduction in range and numbers of the Guam Rail, *Rallus owstoni*, and other native birds (DAWR 1961-1986; Jenkins 1979, 1983; Engbring 1984). Most native forest birds are now either extirpated from the wild or restricted primarily to Northwest Field and Conventional Weapons Storage Area and surrounding cliffline areas on Andersen Air Force Base (AAFB) in Northern Guam.

Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in native bird populations (Conry 1986; Savidge 1986a, 1986b).

A captive breeding program aimed at preserving in captivity Guam's endemic species and subspecies of native forest birds was begun in late 1983 in cooperation with the American Association of Zoological Parks and Aquariums and several of its member zoos (DAWR 1983, Derrickson 1986, Shelton 1986). Efforts at captive breeding the Bridled White-eye, Rufous Fantail and the Guam Flycatcher were abandoned in 1984 due to their disappearance in the wild (DAWR 1984). A total of 31 kingfishers were captured as part of this project and 30 were transported to mainland zoos on three trips from 1984 to 1986 (DAWR 1983-6). During the summer of 1985, the first kingfishers were hatched in captivity at three mainland zoos (Bronx Zoo, Philadelphia Zoo and the Conservation and Research Center of National Zoological park)(DAWR 1985).

Guam Rails were first brought into captivity in 1983 on Guam and bred at the DAWR's rail facility in the spring of 1984 (DAWR 1983-4). By September 30, 1986, there were more than 85 rails and 36 kingfishers in captivity on Guam and at stateside zoos (DAWR 1986).

OBJECTIVES

To develop and implement a captive breeding program for the recovery of the Guam Rail, Micronesian Kingfisher, Marianas Crow, and other endangered native birds as recommended in the Native Bird Recovery Plan.

PROCEDURES

1. Continue the development of a cooperative captive breeding program for the Guam Rail and Micronesian Kingfisher with the AAZPA and its member zoos.

2. Upgrade and enlarge the Guam Rail breeding facility at DAWR office in Mangilao to allow up to 50 birds to be held in captivity.

3. Develop techniques for the successful release of captive-reared birds in the wild once the factors responsible for their decline have been controlled.

4. Conduct study into the breeding biology in the field on Guam of birds that are to be captive bred.

5. Continue to consult with recognized authorities regarding captive breeding methodology, facility design, and captive population management techniques.

6. Consult and coordinate with U.S. Fish and Wildlife Service, U.S. Department of Agriculture, and other government agencies with jurisdiction over the interstate movement and captive maintenance of wildlife. Acquire all necessary local and federal permits.

RESULTS

The DAWR captive breeding facility was enlarged with the addition of two large holding aviaries. Each new aviary holds 12 rails in individual stalls which expands our capacity to a total of approximately 50 rails. In addition, all 9 pre-existing individual 10"X10" aviaries were remodeled into breeding aviaries with the addition of a central partition that will facilitate "gentle introductions".

During the year, 8 rail chicks hatched at the DAWR facility. A total of 5 rails died during this same time period. Three of the deaths were from trauma and 2 were from unknown causes. At the end of the year, there were 21 rails at the DAWR facility and more than 80 at 7 cooperating zoos on the U.S. Mainland.

In early June, 1987, a single rail was located on Andersen Air Force Base at the location where a rail was captured last year (DAWR 1986). An unsuccessful attempt was made to capture it and we have been unable to locate it since. This is the only rail in the wild we are aware of at present, and the only location from which rails have been positively identified since July 1985 (DAWR 1985).

Beth Bahner, Philadelphia Zoological Garden, who is the American Association of Zoological Parks and Aquarium's studbook keeper for the Micronesian Kingfisher, reports that there are approximately 49 kingfishers in captivity at 9 mainland U.S. zoos.

Plans continue to introduce the Guam Rail to Rota during the Summer of 1988. A report on activities for this project appears elsewhere in this Annual Report under Job E-1-4-2,

"Rota Experimental Population" (DAWR 1987).

RECOMMENDATIONS

1. Upgrade and enlarge the Guam Rail breeding facility at DAWR office in Mangilao to allow up to 75 birds to be held in captivity.

2. Continue development of a cooperative captive breeding program for the Guam Rail and Micronesian Kingfisher with the AAZPA and its member zoos.

3. Continue to consult with recognized authorities regarding captive breeding methodology, facility design, and captive population management techniques.

4. Seek funding for transport of birds to zoos for captive breeding from conservation groups and other private sources.

5. Develop techniques for release of captive reared birds into the wild.

LITERATURE CITED

Division of Aquatic & Wildlife Resources 1961-1986. Job Progress Reports - Federal Aid to Fish and Wildlife Restoration, Department of Agriculture, Guam.

Conry, P. J. 1987. In press. High nest predation by the brown tree snake on Guam. Condor.

Derrickson, S.R. 1986. Captive Propagation of the Guam Rail. The Philadelphia Zoo Review 2:19-23.

Engbring, John and F. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: Results of a 1981 survey. U.S. Fish and Wildlife Service. FWS/OBS-84/20.

Jenkins, J.M. 1979. Natural history of the Guam Rail. Condor 81: 404-498

Jenkins, J.M. 1983. The native forest birds of Guam, Ornithological Monograph #31, American Ornithologists Union.

Savidge, J. A. 1986a. The role of disease and predation in the decline of Guam's avifauna. Ph.D. Thesis. University of Illinois, Urbana-Champaign.

Savidge, J. A. 1987. Extinction of an island avifauna by an introduced snake. Ecology 68(3):660-688.

Shelton, L.C. 1986. Captive Propagation of the Micronesian Kingfisher. The Philadelphia Zoo Review 2: 28-31.

Report prepared by: Robert E. Beck, Jr.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 4
JOB NO.: 2

JOB TITLE: Development of an Experimental Population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Planning continued for the introduction of the Guam Rail to Rota in the Commonwealth of the Northern Mariana Island scheduled for the Summer of 1988.

BACKGROUND

Since the creation in 1960 of the Guam Division of Aquatic and Wildlife Resources (DAWR), census data from roadside counts, station counts, and transect counts have documented the reduction in range and numbers of the Guam Rail, *Rallus owstoni*, and other native birds (DAWR 1961-1986; Jenkins 1979, 1983; Engbring and Ramsey 1984). Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in native bird populations (Conry 1986; Savidge 1986a, 1986b). Research efforts are presently underway to develop methods for controlling rail predation by the brown tree snake. However, it is not likely that we will be able to adequately control snake predation on Guam so that we will be able to introduce the rail back into the wild there in the near future .

A captive breeding program for the Guam Rail was successfully begun in 1983 on Guam and at mainland U.S. zoos in cooperation with the American Association of Zoological Parks and Aquariums (DAWR 1984-1986; Derrickson 1986). Guam Rails were first brought into captivity in 1983 on Guam and bred at the DAWR's rail facility in the spring of 1984 (DAWR 1983-4). By September 1986, there were more than 85 rails in captivity on Guam and at stateside zoos.

The DAWR is developing plans to introduce the Guam Rail to Rota in order to develop a self sustaining wild population of rails that will not undergo "domestication" from captive breeding. It is hoped that the experience gained in introducing the rails to Rota will provide valuable information useful for future introductions on Guam. The Rota population may also serve as a partial source of birds for use in reintroducing the rail to Guam when snake predation has been controlled.

OBJECTIVES

To develop and implement a program to establish an experimental population of Guam Rails on Cocos Island, or on Rota or at other suitable locations in the Commonwealth of the Northern Mariana Islands, utilizing captive-bred rails maintained in captivity on Guam and at cooperating mainland zoos.

PROCEDURES

1. Develop a cooperative agreement between the Government of Guam, Commonwealth of the Northern Mariana Islands and the U.S. Fish and Wildlife Service establishing the responsibilities of each entity for the project.

2. Captive breed Guam Rails needed for the introduction on Guam and at mainland U.S. zoos.

3. Develop techniques and methods for introduction of the rail to Rota.

4. Obtain the required permits from the Commonwealth of the Northern Mariana Islands and the U.S. Fish and Wildlife Service.

5. Formalize relationship with Dr. Stuart Pimm, Professor of Zoology, University of Tennessee, in order for him to be able to monitor the progress of the rail introduction to Rota for a period of at least 3 years.

6. Seek funding from conservation organizations to support the monitoring of the introduced rail population on Rota.

RESULTS

A cooperative agreement was signed between the Government of Guam, Commonwealth of the Northern Mariana Islands (CNMI), and the U.S. Fish and Wildlife Service (USFWS) outlining the responsibilities of each entity for the introduction.

Captive breeding of Guam Rails continued and as of September, 1987, there were 21 rails at the DAWR facility and more than 80 at 7 cooperating zoos on the U.S. Mainland.

An environmental assessment was prepared for the USFWS covering the introduction of the Guam Rail to Rota and forwarded to Environmental Services, USFWS, Honolulu. Upon review, it was mutually decided to conduct an insect and reptile survey of Rota to discover the presence of possible endangered species.

Dr. Stuart Pimm, Professor of Zoology, University of Tennessee and the DAWR reached agreement by which a graduate student from the University of Tennessee will reside on Rota for at least three years, monitoring the rail introduction, in cooperation with the DAWR, as a part of his dissertation research. In addition, Dr. Pimm, with the support of the DAWR, applied for research grants to support the monitoring study.

In April, 1987, Robert Beck from the DAWR and Dr. Pimm, accompanied by Phil Glass from the CNMI Fish and Wildlife Division, visited Rota for the purpose of investigating possible sites for the introduction. Sites in Palii and Sinapolo were tentatively selected. In addition, visits were made to various Rota government officials to update them on the status of the project.

Correspondence and discussions continued as to the best methods to be used for the introduction.

RECOMMENDATIONS

1. Finalize permits required for the introduction from the Commonwealth of the Northern Mariana Islands and the U.S. Fish and Wildlife Service.

2. Captive breed Guam Rails needed for the introduction on Guam and at mainland U.S. zoos.

3. Develop techniques and methods for introduction of the rail to Rota.

4. Conduct surveys for reptiles and insects on Rota for purposes of locating possible endangered species.

5. Construct necessary holding facilities on Rota at the site of the release.

6. Seek assistance of the Navy in transporting rails from DAWR captive breeding facility to release site on Rota.

7. Conduct public information meeting on Rota prior to introduction of rails.

8. Implement disease prevention protocol with rails on Guam prior to release on Rota.

9. Implement the introduction of the Guam Rail to Rota during the summer of 1988 or as soon after as feasible.

10. In cooperation with Dr. Stuart Pimm and his graduate student, monitor the success of the initial introduction of Guam Rails to Rota and continue with successive introductions to the island as warranted.

11. Continue to seek funding from conservation organizations to support the monitoring of the introduced rail population on Rota.

LITERATURE CITED

Conry, P. J. 1987, In press. High nest predation by the brown tree snake on Guam. Condor.

Derrickson, S.R. 1986. Captive Propagation of the Guam Rail. The Philadelphia Zoo Review 2:19-23.

Engbring, John and F.L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: Results of a 1981 survey. U.S. Fish and Wildlife Service, Washington, D.C. FWS/OBS-84/20.

Division of Aquatic and Wildlife Resources (DAWR). 1974-1986. Job Progress Reports Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Jenkins, J.M. 1983. The native forest birds of Guam. Ornith. Monogr. 31:1-61.

Savidge, J. A. 1986a. The role of disease and predation in the decline of Guam's avifauna. Ph.D. Thesis. University of Illinois, Urbana-Champaign.

Savidge, J. A. 1986b. Extinction of an island avifauna by an introduced snake. Ecology 68(3):660-668.

Report prepared by: Robert E. Beck, Jr.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 5
JOB NO.: 1

JOB TITLE: Native Bird Status Surveys and Natural History

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

The decline of the native avifauna of Guam continued as shown by roadside counts, transect counts and observations incidental to other activities. A monthly survey of Fena Lake, Naval Magazine for Mariana Gallinules was begun. A monthly survey for Vanikoro Swiftlets in the single cave from which they are known on Guam was begun.

BACKGROUND

Since the early 1960's, census data has documented the decline in both range and numbers of Guam's native land birds. Roadside counts initiated in 1960 over four routes in southern, central and northern Guam by the Guam Division of Aquatic and Wildlife Resources (DAWR), have provided an index to the decline (DAWR, 1974-1986). From 1979 to 1981, estimates of the population trends were made by the DAWR based on variable circular plot techniques (Reynolds et al. 1980) and from station counts in central and northern Guam (DAWR 1980-1982). From June to July of 1981, an intensive forest bird survey utilizing variable-circular plot techniques along randomly located transects were conducted by the U.S. Fish and Wildlife Service with the cooperation of the DAWR (Engbring and Ramsey, 1984). Some of these transects have been repeated in recent years by the DAWR (1982-86).

Native land birds are now primarily restricted to northern Guam with the center of distribution of native forest birds located on Northwest Field and Conventional Weapons Area at AAFB. Exceptions are the the Vanikoro Swiftlet (known only from one cave in central Guam), Mariana Gallinule (found over most of Guam in restricted and declining wetlands), Micronesian Starling (also found on Cocos Island), and the Yellow Bittern (declining but found in savannah and second-growth vegetation over the entire island) (DAWR 1974-1986).

Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in native bird populations (Conry 1987; Savidge 1986a, 1986b).

A captive breeding program for the Guam Rail and Guam subspecies of the Micronesian Kingfisher was successfully begun in 1983 on Guam and at mainland U.S. zoos in cooperation with the American Association of Zoological Parks and Aquariums (DAWR 1984-1986; Derrickson 1986; Shelton 1986).

OBJECTIVES

To continue status surveys and natural history studies as called for in the Recovery Plans for endangered native birds.

PROCEDURES

1. Roadside counts were conducted at bi-weekly intervals on three routes in northern Guam (Figure 1) by DAWR Conservation Officers. These routes were driven at approximately 6-9 km per hour beginning at sunrise. Numbers and species of all birds seen or heard were recorded, irrespective of the distance from the observer.

2. The Pajon Basin (East Ritidian Point) variable circular plot transect was surveyed in April 1987 (Figure 1). This transect has been run on an irregular basis since September of 1981. Stations were located 150m apart along a transect to minimize the possibility of observing the same birds from different stations. Stations were censused using the eight minute variable circular-plot techniques as described by Reynolds et. al. (1980).

3. Several surveys for Guam Rails using tape recorded playbacks of their calls were occasionally conducted at the dog kennel area on AAFB, the last known location to have rails (Figure 1) (DAWR 1986).

4. A survey for Mariana Gallinules at Fena Reservoir, U.S. Naval Magazine was conducted monthly beginning in February 1987 (Figure 1). Three observers began each survey at dawn on upper Fena Reservoir using a canoe. They moved along the entire shoreline of the lake noting all gallinule seen or heard Figure 1). Typically the survey took 4 to 5 hours to complete. The observers moved as far upstream the tributaries as was possible with a canoe.

5. Monthly counts of Island Swiflets were initiated in February at the swiftlet cave near Firebreak 4 on Naval Magazine. Observers sat at both entrances of the cave for a period of 2-2.5 hours before dark and recorded the numbers of birds flying in and out. The total number of birds inhabiting the cave was determined by subtracting the number of departures from the number of arrivals and by adding the number of birds estimated to be in the cave at the start of the count. Prior to each count, observers entered the cave for 0.5-1 hour to look for evidence of nesting and reproductive activity. The presence of nestlings and their calls and the incidence of adult birds that appeared to be incubating eggs or brooding young was noted. In order to avoid disturbing nesting birds, nests were viewed from a slightly elevated position off to the side of the cave rather than by lifting a mirror up to look inside the nests. The cave floor was searched and cleaned each month of eggshell fragments and whole eggs that had fallen from nests overhead.

RESULTS

Roadside counts done on three routes in northern Guam continued to document the decline of native forest birds. For the first time since the northern roadside counts were started, the Guam Rail, White-throated Ground Dove and Micronesian Starling were not observed on any of the three roadside counts done in northern Guam (Tables 1, 2, 3, 4) (DAWR 1986).

Most other resident birds declined from the preceding year (DAWR 1986) as well. For the first time, the Mariana Crow was not observed on the North Roadside count (Figures 1,4). The introduced Black Drongo declined dramatically on the Northwest Field count from a high count of 282.64 in 1986 (DAWR 1986) to 115.96 birds per 100Km (Tables 3,4), while not significantly varying from the very low level observed on the North and North Central routes in 1986 (DAWR 1986).

A single circular plot survey transect was run at East Ritidian Point in April 1987 (Table 5, Fig 1). The only species observed was the Mariana Crow. During the single count done in 1986, no crows were observed (DAWR 1986). Individual crows are still observed from Uruno Basin across the northern coastal forests cliffline forests to Anao Basin in Northeast Guam by DAWR biologists incidental to other activities.

A tape recorded playback of the Guam Rails call was used to census for rails in the "dog kennel" area of Andersen Air Force Base at the location where a rail was accidentally captured in September 1986 (DAWR 1986). A single rail was located in early June, 1987. An unsuccessful attempt was made to capture it and we have been unable to locate it since. This is the only rail in the wild we are aware of at present and the only location from which rails have been positively identified since July 1985 (DAWR 1985).

During the fiscal year, 6 observations of Micronesian Kingfishers were made incidental to various activities by DAWR staff (Table 8). All were on Northwest Field, AAFB (Figure 2). Northwest Field appears to be the sole remaining area on Guam where Kingfishers can be found.

Roadside census work, the circular plot transect done at East Ritidian Point, observations made incidental to Philippine Turtle Dove counts and Mariana Crow nest snakeproofing, suggest that NWF and CWSA on AAFB remain the center of distribution of most of Guam's native forest avifauna.

A monthly survey for Mariana Gallinules was conducted at Fena Reservoir beginning in April 1987. Fena Reservoir is the largest freshwater body of water on Guam and is believed to contain the largest number of gallinules of any area on Guam. Five surveys were completed during the fiscal year from April to September with the maximun total number of Gallinules observed ranging between 22 and 60. The largest number (60) was observed in June at the end of the dry season. Chicks were observed on all surveys except for September. Subadults were observed during all surveys. Nests were observed during the June, August and September surveys. The reservoir level dropped during the first four surveys due to the record dry season on Guam this year, but by September, had begun to increase with the rain generated by several passing typhoons.

The numbers of Island Swiftlets counted during monthly censuses at the Firebreak 4 cave remained fairly constant at about 400-450 birds from February to September 1987 (Table 6). Counts increased slightly to about 450 birds during July to September, however, this increase may have resulted partially from the use of slightly different censusing techniques among counts. These censuses were similar to one of 360-380 swiftlets obtained in April 1986 but were higher than a count of 260-280 birds made in May 1984 (Table 6). These data suggest that an increase in swiftlet numbers may have occurred at the Firebreak 4 cave during the last three years, however, again, slight differences in censusing methods and observer experience may account for some of the variation noted.

Jenkins (1983) reported that eggs have been found in swiftlet nests on Guam from January to July but he conceded that breeding may have gone unrecorded by DAWR staff during the remainder of the year. In the present study, which was limited to eight months, eggs

and young were found in all months although reproductive activity appeared to be highest from March to August. Overall activity was based on the numbers of whole eggs and eggshell fragments found on the cave floor. The number of nestlings heard and the amount of suspected incubation and brooding observed were also important in judging nesting activity (Table 6). This last factor was possibly biased by the influence that the amount of light entering the cave's north entrance during our afternoon observation periods had on the observers ability to view nesting activity inside the cave. Many nests in the cave were partially illuminated from March to early June and this greatly aided in the detection of nestlings.

Poor lighting during the other months of study made viewing of young inside nests more difficult. A preliminary conclusion of this project is that despite the apparent high rate of reproduction in this colony, the cave's population of swiftlets does not appear to be increasing at a corresponding level. This indicates that mortality among nestlings or newly fledged birds may be high. No determination of the cause(s) of mortality, or of the locations where mortality is occurring, was made in the study, however, no dead birds were ever found during our searches of the cave floor.

No evidence of predation on Island Swiftlets by brown tree snakes was noted during the seven visits to the cave in FY 1987. However, one snake was caught and three shed snake skins were found within 50 m of the south entrance of the cave. The snake was seen climbing along the side of a rock outcrop and was quite adept at moving across the generally smooth wall by climbing on small narrow ledges and toeholds. This climbing skill clearly shows that snakes have the capability to reach some swiftlet nests located on the walls of some caves.

RECOMMENDATIONS

1. Continue bi-monthly roadside counts over the three routes in northern Guam.
2. Continue census of the Guam Rail in areas where appropriate.
3. Continue census of the Mariana Crow in order to estimate population size and distribution on Guam.
4. Continue breeding biology studies and attempts to snake-proof nest sites of the Mariana Crow on Guam.
5. Continue monthly censuses and efforts to assess the reproductive activity of Island Swiftlets.
6. Continue monthly Mariana Gallinule counts on Fena Lake.
7. Develop and implement methods for control of the brown tree snake.
8. Continue efforts to captive breed endemic endangered native land birds on Guam and at stateside zoos.
9. Implement plans to translocate captive bred Guam Rails to Rota, C.N.M.I. for purposes of establishing a wild population in a snake-free environment.

LITERATURE CITED

Conry, P. J. 1987, In press. High nest predation by the brown tree snake on Guam. Condor.

Derrickson, S.R. 1986. Captive Propagation of the Guam Rail. The Philadelphia Zoo Review 2:19-23.

Engbring, John and F.L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: Results of a 1981 survey. U.S. Fish and Wildlife Service, Washington, D.C. FWS/OBS-84/20.

Division of Aquatic and Wildlife Resources (DAWR). 1974-1986. Job Progress Reports - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Jenkins, J.M. 1983. The native forest birds of Guam. Ornith. Monogr. 31:1-61.

Reynolds, R.T., J.M. Scott and R.A. Nussbaum. 1980. A variable circular-plot method for censusing birds. Condor 82(3): 309-314.

Savidge, J. A. 1986a. The role of disease and predation in the decline of Guam's avifauna. Ph.D. Thesis. University of Illinois, Urbana-Champaign.

Savidge, J. A. 1986b. Extinction of an island avifauna by an introduced snake. Ecology 68(3):660-668.

Shelton, L.C. 1986. Captive Propagation of the Micronesian Kingfisher. The Philadelphia Zoo Review 2: 28-31.

Report prepared by: Robert E. Beck, Jr. and Gary J. Wiles.

Table 1. Average number of birds per 100 Km observed on the North roadside count during Fiscal Year 1987.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	X/Count	X/100	Km
Yellow Bittern	0.00	2.00	0.00	3.00	4.00	2.00	2.00	2.00	1.00	3.00	1.00	0.00	20.00	0.95	2.41	
Mariana Crow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Black Drongo	5.00	15.00	0.00	8.00	6.00	7.00	14.00	7.00	6.00	6.00	12.00	6.00	92.00	4.38	11.08	
Rufous-fronted Fantail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Mariana Fruit-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Guam Broadbill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Golden Plover	71.00	52.00	0.00	69.00	83.00	85.00	64.00	3.00	0.00	0.00	3.00	19.00	449.00	21.38	54.06	
White-throated Ground-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cardinal Honeyeater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Micronesian Kingfisher	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Noddy Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
P.T. Dove	4.00	11.00	0.00	6.00	3.00	8.00	1.00	9.00	4.00	8.00	10.00	13.00	77.00	3.67	9.27	
Chinese Painted Quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Guam Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Chestnut Mannikin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Eurasian Tree Sparrow	2.00	11.00	0.00	4.00	2.00	14.00	11.00	2.00	4.00	7.00	4.00	2.00	63.00	3.00	7.59	
Micronesian Starling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
White Tern	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.14	0.36	
Km	76.93	79.02	0.00	81.59	78.86	80.15	79.50	78.86	77.41	77.25	80.47	40.56	830.58			
Miles	47.80	49.10	0.00	50.70	49.00	49.80	49.40	49.00	48.10	48.00	50.00	25.20	516.10			
Counts	2.00	2.00	0.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00	0.00	1.00	18.00			

Table 2. Average number of birds per 100 Km observed on the North-Central roadside count during Fiscal Year 1987.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	X/Count	X/100 Km
Yellow Bittern	0.00	1.00	6.00	0.00	1.00	5.00	3.00	1.00	2.00	0.00	2.00	2.00	23.00	1.00	5.04
Mariana Crow	0.00	0.00	0.00	0.00	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	0.17	0.88
Black Drongo	10.00	7.00	12.00	6.00	17.00	7.00	4.00	7.00	9.00	8.00	1.00	13.00	101.00	4.39	22.14
Rufous-fronted Fantail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mariana Fruit-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Broadbill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Golden Plover	324.00	371.00	201.00	320.00	206.00	225.00	276.00	0.00	0.00	0.00	7.00	68.00	1998.00	86.87	437.2
White-throated Ground-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cardinal Honeyeater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micronesian Kingfisher	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Noddy Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P.T. Dove	15.00	14.00	8.00	10.00	13.00	26.00	12.00	14.00	26.00	12.00	12.00	8.00	170.00	7.39	37.26
Chinese Painted Quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chestnut Mannikin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	0.00	0.00	0.00	15.00	0.65	3.29
Eurasian Tree Sparrow	7.00	0.00	6.00	3.00	2.00	2.00	0.00	4.00	5.00	10.00	0.00	23.00	62.00	2.70	13.59
Micronesian Starling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	0.30	1.53
Km	39.11	39.91	39.59	42.65	38.62	40.72	38.46	40.72	39.59	39.27	38.14	19.47	456.25		
Miles	24.30	24.80	24.60	26.50	24.00	25.30	23.90	25.30	24.60	24.40	23.70	12.10	283.50		
Counts	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	0.00	1.00	20.00		

Table 3. Average number of birds per 100 Km observed on the Northwest Field roadside count during Fiscal Year 1987.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	X/Count	X/100 Km
Yellow Bittern	7.00	0.00	1.00	0.00	2.00	0.00	0.00	0.00	3.00	5.00	2.00	1.00	21.00	0.88	4.69
Mariana Crow	3.00	2.00	0.00	8.00	1.00	6.00	0.00	10.00	5.00	9.00	16.00	2.00	62.00	2.58	13.85
Black Drongo	117.00	63.00	41.00	39.00	11.00	18.00	56.00	49.00	41.00	35.00	24.00	25.00	519.00	21.63	115.96
Rufous-fronted Fantail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mariana Fruit-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Broadbill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Golden Plover	65.00	33.00	47.00	24.00	209.00	33.00	9.00	0.00	0.00	5.00	0.00	30.00	455.00	18.96	101.66
White-throated Ground-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cardinal Honeyeater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micronesian Kingfisher	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00	2.00	0.08	0.45
Noddy Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P.T. Dove	51.00	14.00	23.00	14.00	9.00	13.00	33.00	52.00	42.00	32.00	59.00	21.00	363.00	15.13	81.11
Chinese Painted Quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chestnut Mannikin	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eurasian Tree Sparrow	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	9.00	0.00	0.00	11.00	0.46	2.46
Micronesian Starling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Km	38.14	36.85	37.01	38.95	38.30	35.73	36.05	39.75	37.01	37.34	37.66	34.76	447.56		
Miles	23.70	22.90	23.00	24.20	23.80	22.20	22.40	24.70	23.00	23.20	23.40	21.60	278.10		
Counts	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	0.00	2.00	22.00		

Table 4. Results of Northwest Field, North, and North Central roadside counts showing the mean number of birds per 100 Km of travel, the standard deviation (St. Dev.) and the coefficient of variation (CV).

Species	Northwest Field			North			North Central		
	Mean	St. Dev	CV	Mean	St. Dev.	CV	Mean	St. Dev.	CV
Yellow Bittern	4.84	1.27	139.59	2.53	1.30	129.78	4.81	1.25	131.24
Yellow Bittern	4.69	1.23	26.15	2.41	1.28	53.31	5.04	1.24	24.66
Mariana Crow	13.85	3.45	24.91	0.00	0.00	0.00	0.88	0.83	95.13
Black Drongo	115.96	14.62	12.61	10.35	2.83	27.30	22.14	3.26	14.72
Rufous-fronted Fantail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mariana Fruit-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Broadbill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Golden Plover	95.63	40.49	42.34	54.06	19.34	35.77	437.92	82.06	18.74
White-throated Ground-Dove	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cardinal Honeyeater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Micronesian Kingfisher	0.45	0.28	63.18	0.00	0.00	0.00	0.00	0.00	0.00
Noddy Tern	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
P.T. Dove	81.11	9.12	11.25	9.27	3.21	34.67	37.26	5.19	13.94
Chinese Painted Quail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Guam Rail	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Chestnut Mannikin	0.00	0.00	0.00	0.00	0.00	0.00	3.29	3.13	95.13
Eurasian Tree Sparrow	2.46	1.86	75.86	7.59	2.65	34.88	13.59	5.11	37.62
Micronesian Starling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
White Tern	0.00	0.00	0.00	0.36	0.48	132.37	1.53	1.46	95.13

Table 5. Forest birds seen at Pajon Basin on transect counts. Numbers are average total number of birds counted by 2 observers at ten stations at Pajon Basin (East Ritidian Pt.), Guam from September 1981 to April 1987.

Species	DATE												
	6/18/81*	6/2/82	5/19/83	6/28/83	7/28/83	8/31/83	9/30/83	10/27/83	12/5/83	5/15/84	1/29/85	3/26/86**	4/21/87
Guam Rail	0	0	0	0	0	1.0	0	0	0	0	0	0	0
Mariana Fruit-Dove	5.5	9.5	2.0	1.0	1.0	2.0	0	0	0	0	0	0	0
Philippine Turtle-Dove	0	0	0	3.0	2.5	15.5	21.5	10.5	17.0	9.5	0.5	0	0
White-throated Ground-Dove	.5	1.5	4.5	1.0	0	4.0	1.5	1.5	1.5	2.5	0	0	0
Micronesian Kingfisher	14.5	8.5	12.0	23.0	18.0	15.5	18.0	9.5	20.0	13.0	2	0	0
Mariana Crow	14	16.5	18.6	28.0	25.5	25.0	20.0	26.5	32.5	18.0	25.5	0	3.0
Rufous-fronted Fantail	36.5	27.5	22.0	21.5	6.0	2.0	2.0	1.5	0	0	0	0	0
Guam Broadbill	3.0	11.5	2.5	8.5	10.5	8.0	6.0	1.0	0	0	0	0	0
Micronesian Starling	76.0	79.5	71.5	63.0	75.0	61.0	48.5	51.0	41.0	35.5	3.5	0	0
Cardinal Honeyeater	15.5	16.5	15.5	17.0	17.0	9.0	9.5	15.0	4.0	1.0	0	0	0
Bridled White-eye	54.0	49.0	1.5	0	0	0	0	0	0	0	0	0	0

* 1981 survey was conducted by U.S.F.W.S. and DAWR staff. 1982 to 1987 survey was conducted by DAWR staff.
** On 3/26/86 survey only 7 stations were completed due to inclement weather.

Table 6. Results of censuses for Island Swiftlets at the Firebreak 4 Cave on Naval Magazine from 1984, to 1987. Evidence of reproductive activities of swiftlets is also presented.

Date	Net No. of Birds Entering Cave	No. of Birds Estimated in Cave at Start of Count	Total No. of Birds Counted	Reproductive Parameters				
				No. of Whole Eggs Found	No. of Eggshell Fragments Found	No. of Nestlings Heard	No. of Nestlings Seen	Incubation or Brooding Observed
22 May 1984	233	25-50	258-283					
17 April 1986	333	25-50	358-383					
25 Feb 1987	366	20	386	4[a]	present [a,b]	several	none	yes
30 Mar 1987	371	20	391	5	present[b]	several	many	yes
22 April 1987	354	30	384	3	39	several	some	yes
1 June 1987	358	30	388	5	39	several	some	yes
28 July 1987	396	50	446	8[a]	29[a]	several	some	yes
25 Aug 1987	390	40	430	7	20	several	some	undetermined
27 Sep 1987	360	75	435	1	14	several	none	undetermined

[a]Data is for more than one month
[b]Present but numbers were not counted

Table 7. Number of Mariana Gallinules observed on monthly Fena Reservoir counts from 4/21/87 to 9/17/87.

	Date				
Age Group	**4/21/87**	**5/22/87**	**6/25/87**	**8/14/87**	**9/17/87**
Adults	19	46	40	29	6
Subadult	1	2	16	8	12
Chicks	2	10	2	3	0
Unknown age	0	0	2	1	4
Total	22	58	60	41	22
Active Nests	0	0	1	2	1
Reservoir Level (ft)	102	98	93	91	96

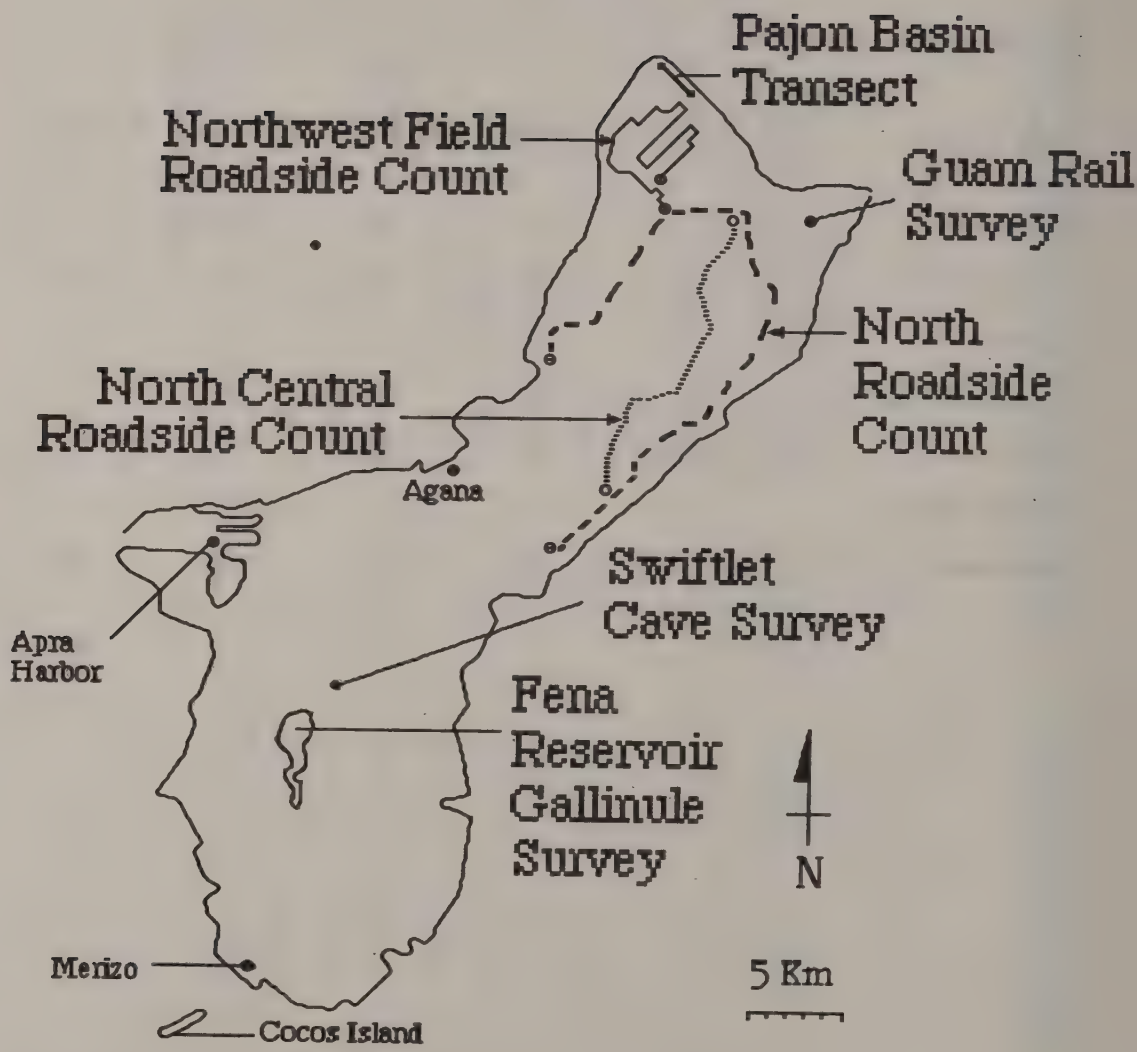

Figure 1 - Map of Guam showing the location of Fena Reservoir Mariana Gallinule survey, Vanikoro Swiftlet cave survey, Guam Rail survey, Pajon , Pajon basin transect, and North, North Central, and Northwest Field roadside count routes.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 5
JOB NO.: 2

JOB TITLE: Habitat Protection and Management for the Native Birds of Guam

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Attempts were made to snake-proof 6 Mariana Crow nest trees containing actively incubating pairs. All nests failed to hatch young. The cause of the failure could not be positively determined, but snake predation is suspected.

BACKGROUND

Since the creation in 1960 of the Guam Division of Aquatic and Wildlife Resources (DAWR), census data from roadside counts, station counts, and transect counts have documented the reduction in range and numbers of the Guam Rail, *Rallus owstoni*, and other native birds (DAWR 1961-1986; Jenkins 1979, 1983; Engbring and Ramsey 1984). Most native forest birds are now either extirpated from the wild or restricted primarily to Northwest Field and Conventional Weapons Storage Area and surrounding cliffline areas on Andersen Air Force Base (AAFB) in Northern Guam. The Island Swiftlet, *Aerodramus vanikorensis bartschi*, is now restricted to the vicinity of Naval Magazine (NAVMAG) and the Mariana Gallinule, *Gallinula chloropis guami*, is still found at Fena Reservoir at NAVMAG and in other wetland areas around the island.

A captive breeding program for the Guam Rail, and Guam subspecies of the Micronesian Kingfisher, was successfully begun in 1983 on Guam and at mainland U.S. zoos in cooperation with the American Association of Zoological Parks and Aquariums (DAWR 1984-1986; Derrickson 1986; Shelton 1986). Draft Recovery Plans have been prepared for the native forest birds of Guam, the Island Swiftlet, and the Mariana Gallinule (USFWS in prep.). Each of these plans makes specific recommendations for habitat management and protection measures that should be implemented to ensure the recovery of the species.

Because the brown tree snake has been implicated as the primary cause of the decline of Guam's native birds (Conry 1987; Savidge 1986a, 1986b), the DAWR began to experiment with the snake-proofing of both Guam Micronesian Kingfisher and Mariana Crow active nests during the spring and summer of 1985. Sam Marshall, New York Zoological Society, spent the summer of 1985 on Guam studying the breeding biology of the kingfisher (Marshall in prep). As a part of his study, and in cooperation with the DAWR, a single kingfisher nest site was snake-proofed using a 4' galvanized sheet metal sleeve on the trunk of the nest tree. In addition, nearby vegetation was trimmed back to

prevent inter-tree movement of the brown tree snake. A single kingfisher was successfully fledged and collected from the site, and is now part of our captive breeding program (DAWR 1985).

Gary Michael, Philadelphia Zoological Society, visited Guam during the fall of 1985 and studied the breeding biology of the Mariana Crow for 3 months (Michael 1986). During that period, the DAWR and Michael attempted to snake-proof several crow nest trees. The method used was similar to that mentioned above for the kingfisher, and involved encircling the trunk of the nest tree with a 4' long sleeve of galvanized sheet metal 4' to 6' above the ground. In addition, all surrounding vegetation was trimmed so that the brown tree snake could not move through the canopy into the nest tree. However, no crow nesting attempts observed during this period were successful (DAWR 1985).

Time, money and manpower constraints have prevented implementation of habitat protection and management measures for other species of bird such as the swiftlet and the gallinule.

OBJECTIVES

To determine the quantity and quality of habitat necessary to maintain self-sustaining populations of native birds, to provide continued habitat protection as called for in the Native Forest Bird Recovery Plan, and to implement direct habitat protection and improvement actions.

PROCEDURES

1. Locate active Mariana Crow nest sites on Guam.

2. Develop and implement methods for snake-proofing Mariana Crow nest sites.

3. Consult with herpetologists working on the control of the brown tree snake as to appropriate methods for snake-proofing crow nest sites.

4. Implement habitat protection and management measures for other bird species as manpower and funding permit.

RESULTS

During the fiscal year, this project was active on a part-time basis only as staff became available. Often, crow nests were located incidental to other activities that DAWR staff were conducting. A total of 46 crow nests were found with 33 in the Conventional Weapons Storage Area, 7 in Northwest Field, 4 adjacent to the Weapons Storage Area and 2 at Pati Point, all at Andersen Air Force Base. No systematic census of crows on Northern Guam was conducted and the numbers compiled above do not necessarily represent the relative abundance of crow nesting in each area.

Attempts were made to snake-proof 6 nest sites. All were located in emergent *Elaeocarpus* trees. Each tree selected for snake-proofing was observed to have an actively incubating crow pair. In order to not disturb the incubating birds, no attempt was made to observe the nest contents, which, in all cases, would have been difficult since all nests were located very high (<40') in emergent trees. Previously, as a part of Michael's study (Michael 1986), the behavior of incubating crows had been carefully documented and we felt confident that we could detect incubating crows without actually observing eggs in the nest.

In all cases, the surrounding vegetation was trimmed back so snakes could only approach the nest via the main trunk. Each tree was visually searched for the presence of snakes from the ground after snake-proofing. No snakes were ever found in the trees. Two nest trees were snake-proofed by placing a 4' long galvanized sheet metal sleeve around the trunk approximately 6' above the ground to prevent the movement of the snake up the trunk. Two others were "tanglefooted" in addition to the attachment of the metal sleeve. Tanglefoot, a sticky and very thick commercial liquid with the consistency of syrup, was applied in a 3' band around the trunk of the tree below the metal sleeve to inhibit snake movement. Two additional trees had 6 and 12 snake traps respectively placed around their base. The traps were funnel traps baited with live *Coturnix* sp. quail, a type of bird that had previously been successfully used by Savidge (1986a, 1986b) to capture snakes.

All 6 snake-proofed nests failed to fledge young. It was not possible to observe the contents of each nest after abandonment except by spotting scope from a distance. It was not possible to establish the cause of the unsuccessful nesting. However, in all cases, the nests appeared undamaged. This is suggestive of snake predation.

Throughout the entire study, no crows were observed to successfully incubate eggs. No juvenile crows have been observed since 1985 (DAWR 1985).

RECOMMENDATIONS

1. Continue efforts to locate active Mariana Crow nest sites.

2. Continue to consult with herpetologists working on control of the brown tree snakes to develop more effective methods of snake-proofing nest sites.

3. Hire a full-time biologist to carry out this study.

4. Continue to snake-proof active nest sites where possible.

5. Attempt to snake-proof all possible nest trees in entire territory of actively breeding Mariana Crow nest pairs before actual nesting.

6. Attempt to snake-free discrete units of habitat utilized by crows and other native birds.

7. Extend habitat protection and management activities to other species such as the Island Swiftlet and Mariana Gallinule as time and manpower permit.

LITERATURE CITED

Conry, P. J. 1987, In press. High nest predation by the brown tree snake on Guam. Condor.

Engbring, John and F.L. Ramsey. 1984. Distribution and abundance of the forest birds of Guam: Results of a 1981 survey. U.S. Fish and Wildlife Service, Washington, D.C. FWS/OBS-84/20.

Division of Aquatic and Wildlife Resources (DAWR). 1974-1986. Job Progress Reports - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Jenkins, J.M. 1983. The native forest birds of Guam. Ornith. Monogr. 31:1-61.

Marshall, Sam in prep. Nest site characteristicsa of the Micronesian Kingfisher on Guam: Habitat variables and habitat choice. 15pp.

Michael, Gary 1986. A field study of the Mariana Crow. The Philadelphia Zoo Review 2: 11-18.

U. S. Fish & Wildlife Service, A) In prep. Recovery Plan for the Native Forest Birds of Guam. B) In prep. Recovery Plan for the Island Swiftlet on Guam and in the Northern Marianas Islands. C) In prep. Recovery Plan for the Mariana Common Moorhen on Guam and in the Northern Mariana Islands.

Savidge, J. A. 1986a. The role of disease and predation in the decline of Guam's avifauna. Ph.D. Thesis. University of Illinois, Urbana-Champaign.

Savidge, J. A. 1986b. Extinction of an island avifauna by introduced snake. Ecology 68(3):660-668.

Report prepared by: Robert E. Beck, Jr. and Gary J. Wiles.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 6
JOB NO.: 1

JOB TITLE: Law Enforcement and Legal Protection for the Marianas Fruit Bats

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

This job was relatively inactive during this segment. Activity mainly consisted of monitoring fruit bat imports, documenting fruit bat seizures, and investigating incidents of colony disturbance for signs of illegal hunting activity. Results of this activity was consolidated with other fruit bat research and is reported under Job E-1-2, Natural History, Biology and Habitat Protection for the Marianas Fruit Bat, which ran concurrently.

Report prepared by: Gary J. Wiles

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 6
JOB NO.: 2

JOB TITLE: Natural History, Biology, and Habitat Protection for the Marianas Fruit Bats

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Guam's fruit bat population is currently estimated at 500 to 600 animals. Bat colonies used six roosts on Pati Point during the year. A continued low incidence of young bats was noted on Guam and contrasted greatly with the large number of young observed on Rota. This provides additional evidence that brown tree snakes are preying heavily on Guam's fruit bats. No known successful cases of illegal hunting of bats occurred during the year although one probable attempt was recorded and a report of poaching was received. In FY 1987, 9,404 frozen fruit bats were imported to Guam from other islands for human consumption, a decrease of 30.1% from the previous year.

BACKGROUND

The Marianas fruit bat (*Pteropus mariannus mariannus*) is endemic to the Mariana Islands and has been under investigation by the Guam Division of Aquatic and Wildlife Resources (DAWR) since 1962 (DAWR 1964-1986). These bats, considered a delicacy by Chamorro residents, steadily declined in number during the 1960s (Perez 1972). Thereafter, annual surveys revealed that only a few dispersed, solitary bats remained in the prime habitat on Guam which once supported colonies containing hundreds of bats (Wheeler and Aguon 1978, Wheeler 1979). Reasons for the decline included: increased human population pressures that resulted in overhunting and permanent habitat destruction, commercial exploitation of this food species, periodic severe typhoons, the lack of an adequate enforcement staff, and delays by the local legislature in passing protective legislation (Wheeler 1979). The Marianas fruit bat and the little Marianas fruit bat (*P. tokudae*) finally received full protection from hunting in 1973. Both species were placed on Guam's territorial Endangered Species List in 1981 and on the U.S. Endangered Species List in August 1984. The island's population of Marianas fruit bats grew substantially to an estimated 850 - 1,000 animals between 1980 and 1982, probably from immigration of bats from Rota (Wiles, in press, a). However, numbers have declined since 1983 because of continued illegal hunting and suspected predation on bats by brown tree snakes (*Boiga irregularis*) (Wiles, in press, a; in press, b). Guam's fruit bat population was estimated at 525-625 animals in FY 1986.

OBJECTIVES

To continue status surveys and natural history studies and to provide for continued protection of habitat as called for in the Fruit Bat Recovery Plan.

PROCEDURES

1. Survey fruit bat distribution and numbers in Guam and the Commonwealth of the Northern Mariana Islands (CNMI) as initiated in the late 1970s.

    a. Conduct annual surveys of fruit bats along Guam's northern cliffline with periodic surveys made elsewhere on the island. The emphasis of surveys should be to search for solitary bats and additional bat colonies.

    b. Conduct monthly censuses at known bat colonies on Guam.

    c. Assist the CNMI Division of Fish and Wildlife (CNMIDFW) with surveys of fruit bats on other islands as needed.

2. Record information on the behavior and reproduction of fruit bats in colonies.

3. Determine habitat use of fruit bats. Visit abandoned roost colonies and record information about terrain and the size and abundance of vegetation present.

4. Monitor fruit bat imports to Guam from other islands in Micronesia and the Pacific.

5. Investigate illegal hunting of fruit bats on Guam.

    a. Visit abandoned roosting sites of colonies to determine illegal hunting effort.

    b. Assist Conservation Officers with investigations of bat poaching.

RESULTS

Locations of Bat Colonies on Guam

Fruit bats roosted at six known sites on Pati Point during FY 1987. Roost 17 was the main colony site occupied from October to February of FY 1987 although Roost 1 was also used briefly twice during this period (Table 1). Both sites have been used extensively in the past (Table 1) (DAWR 1981-1986). Four other roosts were inhabited for periods of several weeks to several months from February to September (Table 1). Three of these were located on the east side of Pati Point and included Roost 18, which was used for 11 weeks from February to May, Roost 19, which was used for 3 weeks in June and July, and Roost 16, which was used for at least 10 weeks from July to the end of September. Roost 15, found at the northeast tip of Pati Point, was occupied for 8 weeks from May to July.

Attempts were made to determine the causes for the seven changes in roost sites that occurred in FY 1987. A deer hunter entered Roost 17 and caused that site to be abandoned. The man became lost during a special deer hunt held on the cliffline at Tagua Point on 21 February 1987. He walked far to the east of the area designated for deer hunting and ended up under the bat roost on the northeast corner of Pati Point. Apparently no hunting occurred in this incident. Two colony movements away from Roosts 1 and 15

occurred during the passing of a typhoon in early December and a tropical storm in early July, respectively. Both storms had winds of 15-30 mph blowing from the west and southwest. In each case, the colony appeared to move to a new location that was better protected from the prevailing winds. In late May, Roost 1 was abandoned by a small group of bats which probably left to join the much larger colony at Roost 15. The causes for 3 other changes in roosts were not determined. Searches were made at Roosts 17 and 18 to look for evidence that illegal hunting had occurred and caused the abandonment of the roosts, however, no signs of poaching were found during these searches.

Survey of Fruit Bats on Guam

Censuses of fruit bats at Roosts 1 and 17 varied little from October to January, ranging from 406 to 432 animals (Table 2). Counts made after January at Roosts 15, 16, 18 and 19 were much lower and varied from 151 to 356 bats (Table 2). The lower counts may have resulted from the colony inhabiting roosts where viewing was poor and more bats than usual were not visible. Several searches of the oceanside cliffline between Pati and Lafac Points revealed no additional roosts of bats in the vicinity of known roosts. Similarly, no other colonies were found during a search from Ritidian to Mergagan Points conducted in April, and no reports of colonies elsewhere on the island were obtained during the year. A final count of 386 bats was obtained on 22 October 1987 (at the start of FY 1988) at Roosts 15 and 17 where viewing conditions were much improved (Table 2).

The October 1987 count is probably more reflective of actual fruit bat numbers on Pati Point during latter half of FY 1987. Therefore, that count was used for estimating the island's population of fruit bats at the end of FY 1987. Because some individuals were probably hidden by thick foliage during that count, the total number of adults in the two colonies was likely to be 10 to 20% higher than the actual number recorded. In addition, approximately 12% of these animals possessed unweaned young (see Natural History). These figures provide an estimate of 425 to 465 adults and 30 to 35 juveniles, or a total of 455 to 500 bats, in Roost 16 during September.

Daytime sightings of solitary fruit bats were made during the year in the Conventional Weapons Storage Area on AAFB (2 sightings), in Northwest Field (3 sightings), along the clifflines at Ritidian Point (1 sighting), Uruno Point (1 sighting), Lafac Point (1 sighting), and Mergagan Point (2 sightings), and along the south and central shorelines of Fena Lake at Naval Magazine (6 sightings). One sighting of a bat was made at night at Asdonlucas near Pagat, Yigo. In addition to the colony at Pati Point, an estimated 25 to 50 fruit bats are believed to live solitarily or in small groups along the island's northern cliffline that extends from Bijia Point to Iates Point. An additional 25 to 50 animals probably inhabit Naval Magazine, Talofofo and Malojloj. Based on these figures, Guam's island-wide population of fruit bats is estimated to contain 500 to 600 animals. This amount is slightly lower than the FY 1986 estimate of 525 to 625 animals (DAWR 1986).

Survey of Fruit Bats on Rota

The DAWR assisted the CNMIDFW again this year with a survey of fruit bats on Rota from 27 April to 1 May. Three bat colonies were found during the survey. Counts of roosting bats were made at two sites, Uyulan Hulo and Sagua Pakpak, with a 15-60X spotting scope and were increased by 10-20% to account for bats hidden in foliage. At Uyulan Hulo, 1,217 bats were counted with an estimate of 1,340-1,420 animals made. At Sagua Pakpak, 504 bats were counted and 550-600 estimated to be present. A third colony at As Puepuenge was not visited but an evening departure count made several days later by Stan Taisacan of the CNMIDFW indicated that about 75 animals were present. One former colony site at Palii was visited during the survey and was found to have no bats.

Occasional solitary bats were noted during station counts around the island and probably totaled several hundred animals. Based on these counts, a total of approximately 2,150-2,500 bats are estimated to reside presently on Rota.

Other information gathered during the survey included observations on the incidence of harem females with young (see Natural History) and on the foods of bats. Data gathered from this trip will be used by the CNMIDFW to write a more detailed report on the abundance and ecology of fruit bats on Rota.

Natural History

Reproduction - During FY 1987, 50 to 95 harem females were identified monthly at roosts on Pati Point and examined visually through a spotting scope for the presence of unweaned young. Females with young comprised 4.0 to 27.4% of the females identified monthly (Table 3). As in FY 1985 and FY 1986 (DAWR 1985, 1986), most (90%) of the juveniles observed were judged to be small-sized; only one large young was observed during the year.

Observations of female fruit bats were also made on Rota in April and revealed a much higher percent of young in the island's two colonies. More than half of the 117 females seen were accompanied by young (Table 3). In further contrast to the situation on Guam, only 32% of the young bats seen were classified as small-sized while 43% were judged as medium-sized and 25% as large-sized. These figures are similar to reproductive rates observed on Guam in 1983 (Wiles, unpubl. data) when the island's fruit bat colony roosted in areas that still retained a variety of native bird species. These comparative data further suggest that juvenile bats on Guam are being lost by predation, as noted previously (DAWR 1986, Wiles, in press, b), and that brown tree snakes, as the only arboreal predator on the island, are responsible. Snakes have not yet invaded Rota. Reproductive rates of bats on that island probably reflect normal conditions.

Illegal Hunting

Poaching has long been a major cause of mortality of *P. mariannus* on Guam and other islands in the southern Marianas (Wiles, in press, a; Wiles et al., in prep.). No cases of illegal hunting were recorded on Guam in FY 1987. This is the second consecutive year in which there has been no known poaching of fruit bats. The instance of the deer hunter wandering into the bat roost at Roost 17 was apparently accidental and did not involve any taking of bats (see Locations of Bat Colonies of Guam).

Two other incidents occurred during the year that indicate the threat of poaching still remains. One probable attempt to hunt bats was observed on 18 July 1987 at 1400 hr when the U.S. Coast Guard encountered a hunting party returning to a boat that was anchored close to the shore off North Pati Point. They saw three men swimming back to the boat with each man having a shotgun or rifle and one carrying a loaded knapsack. The fruit bat colony, which was located on 450 m south of the cliffline at Roost 19, was apparently not disturbed that day and the Coast Guardsmen did not notice any bats flying above the north side of the point in a disturbed manner. However, it seems likely that the hunters had gone ashore expecting to find the colony at one of its former locations along the north cliffside of Pati Point that had been occupied earlier in the year. Also during the year, one report of possible poaching was received from a resident whose acquaintances had told her that they had hunted fruit bats and deer on Pati Point sometime during September or October 1986.

Fruit Bat Imports

During FY 1987, 45,386 fruit bats were requested for import (Table 4), a decrease of 49.9% from the previous year (DAWR 1986). Despite this decline, the number of import permits issued by the DAWR increased to 508 during FY 1987, a rise of 61.8% over FY 1986. This indicates that far fewer bats were requested per permit in FY 1987 but that importers obtained more permits.

An estimated total of 9,404 frozen fruit bats in 215 shipments were actually shipped to Guam from other islands in FY 1987 (Table 5). These figures represent a 30.1% decrease in the estimated number of bats imported to Guam and a 60.4% increase in the number of shipments received when compared to FY 1986 (DAWR 1986). Palau was the major source of fruit bats for the Guam market in FY 1987, exporting 7,092 animals during the year (Table 5). This amount represented 75.4% of the total number of bats imported to Guam. Shipments from Palau were mostly small in size, averaging 41.2 bats per shipment and ranging from 1-300 animals. Pohnpei (1,075 bats) and Truk (646 bats) were the second and third largest exporters of fruit bats, respectively, and together represented 18.3% of the import total for FY 1987. During the previous several years, sizable imports of bats entered Guam from islands outside of Micronesia, particularly Western Samoa (Wiles and Payne 1986; DAWR 1983-1986). The end of these shipments in FY 1987 was clearly compensated for by importers bringing in increased numbers of bats from Palau. Many of this year's importers were Palauans who presumably intended to sell or give their bats to Chamorro residents.

The large number of fruit bats entering Guam from the Caroline Islands in FY 1987 represents a significant change in sources of imports from the previous four years. This year's sudden shift undoubtedly occurred as a result of Guam's major importer and retailer of bats since 1983, M.P. Enterprises, bringing in almost no bats to Guam during the entire year. This company, which exploited sources that were almost entirely from outside of Micronesia, brought in two shipments from Western Samoa totaling 300 bats during the year. This firm eventually went out of business in late FY 1987.

Surprisingly, few or no bats were imported to Guam from the Philippines, Indonesia or Kosrae during FY 1987. The Philippines was an important supplier of bats in FY 1986 but this year, only two shipments, both of which were confiscated, were received. Despite considerable interest from one businessman about importing bats on a regular basis from Sulawesi, Indonesia, no shipments were actually brought from there or other islands in the country during the year. Garuda Airlines continues to make a weekly flight between Guam, Sulawesi, and Bali. Continental Airlines began making a weekly flight to Kosrae in December 1986 after the completion of that island's new airport, however, this did not result in any subsequent shipments of fruit bats from there during the year.

During FY 1987, 802 fruit bats in 44 shipments were confiscated by the Guam Customs and Quarantine Division upon entry into Guam. These figures represented 8.5% of the total bats brought to the island and 21.5% of the shipments received during the year. Shipments were seized for a variety of violations including lack of import permits, lack of certificates of origin, or because the bats originated from islands where they were protected by local laws.

A report obtained this year from reliable sources in the CNMI indicates that unknown numbers of fruit bats continue to be smuggled into Guam from Rota. The bats are reportedly taken on small boats also carrying illegal shipments of marijuana and are transferred from one boat to another at meeting points midway between Rota and Guam.

Similar reports of smuggling have been obtained during the previous two years (DAWR 1985-1986).

RECOMMENDATIONS

1. Survey bat numbers and distribution along Guam's entire northern cliffline once or twice annually. Searches for additional colonies may prove to be productive because continued poaching at bat roosts on Rota (Wiles, pers. observ.) could cause large numbers of bats to move to Guam.

2. Continue to make observations at Guam's bat colonies. Information should be gathered on reproductive biology, behavior within the colonies, and the sex and number of bats present.

3. Known bat roosting and foraging areas should be patrolled regularly by Conservation Officers. Part of their effort should be aimed at maintaining a visible presence at Jinapsan and Pajon Points, where poaching has been a serious problem in previous years.

4. Determine the amount of predation on fruit bats by brown tree snakes. The age classes of bats that are most susceptible to predation by snakes must be investigated. The extent of predation occurring at colonies and during foraging at night should be determined.

5. Form a cooperative bat research program with the CNMI to collect information on the locations and sizes of colonies, reproductive biology and behavior within colonies. Most of the work done under this program would be conducted on Rota where a relatively large bat population is found but where logistics prevent the CNMI from doing extensive fieldwork. Emphasis of this project would be to identify colonies should they move between Guam and Rota.

6. Continue to monitor fruit bat imports entering Guam. Export permits or certificates of origin should continue to be required for all shipments to ensure that the bats have been legally harvested, that the place of origin is known, and that the government authorities at the place of origin are aware of the drain on their fruit bat populations.

LITERATURE CITED

Division of Aquatic and Wildlife Resources. 1964-1986. Job Progress Reports - Federal Aid to Fish and Wildlife Restoration, Guam. Department of Agriculture, Government of Guam, Agana, Guam.

Perez, G.S.A. 1972. Observations on Guam bats. Micronesica 8:141-149.

Wheeler, M.E. 1979. The Marianas fruit bat: management history, current status and future plans. Calif.-Nev. Wildl. Trans. 10:149-165.

Wheeler, M.E. 1980. The status of the Marianas fruit bat on Saipan, Tinian, and Rota. 'Elepaio 40:109-113.

Wheeler, M.E. and C.F. Aguon. 1978. The current status and distribution of the Marianas fruit bat on Guam. Aquatic and Wildlife Resources Division, Tech. Rep. No. 1, 29 pp.

Wiles, G.J. and N.H. Payne. 1986. The trade in fruit bats *Pteropus* spp. on Guam and other Pacific islands. Biol. Conserv. 38:143-161.

Wiles, G.J. in press, a. Status of fruit bats on Guam. Pacific Science.

Wiles, G.J. in press, b. Current research and future management of Marianas fruit bats (Chiroptera pteropodidae) on Guam. Australian Mammalogy.

Wiles, G.J., T.O. Lemke, and N.H. Payne. in prep. Population estimates of *Pteropus mariannus* in the Mariana Islands.

Report prepared by: Gary J. Wiles

Table 1. Approximate dates of use of 19 roost sites used by colonies of Marianas fruit bats on Guam from FY 1981-FY 1987. Names of roosts used in previous years have been changed to a single numbered system to allow for easier reference and recognition among years. Roosts used in FY 1987 are designated with an asterisk (*).

Roost number	Roost name used in previous annual reports	Approximate periods of use by bats
*1	North Pati Point, North Pati Point Site 1	27 Jan-14 May 81, 24 Jun 81-10 Jun 85, 13 Dec 85-11 Jan 86, 10 Feb-17 Mar 86, 8 Aug 86, 8 Oct-1Dec 86, 19 Dec 86
2	Weapons Storage Area	1 Mar-15 Jun 81
3	East Pati Point	15-24 Jun 81
4	North Jinapsan Point	25 Dec 82-1 May 83, 6 Dec 83-1 Feb 84
5	South Jinapsan Point	1-30 May 83
6	East Ritidian Point	30 May-27 Jun 83
7	South Pajon Point	27 Jun-9 Jul 83
8	North Tarague Cliffline Site 1	9 Jul-10 Nov 83
9	North Jinapsan Basin Site 1	10 Nov-6 Dec 83
10	North Tarague Cliffline Site 2	6 Dec 83-11 Apr 84
11	North Jinapsan Basin Site 2	25 May-3 Jun 84
12	North Jinapsan Basin Site 3	2 Jun-1 Jul 84
13	East Ritidian Point	1 Jul-1 Nov 84
14	North Pati Point Site 2	10-17 and 20-22 Jun 85
*15	North Pati Point Site 4	19 Jun 85, 11 May-3 Jul 87
*16	East Pati Point	10-17 Jun 85, 15 Jul 87-present
*17	North Pati Point Site 3	18 Jun 85-10 Feb 86, 17 Mar-8 Aug 86, 10 Aug 86-21 Feb 87
*18	not used previously; located on East Pati Point	22 Feb-11 May 87
*19	not used previously; located on East Pati Point	21 Jun-15 Jul 87

Table 2. Counts of Marianas fruit bats at roosts on Anderson Air Force Base, Guam in FY 1987 and early FY 1988.

Date	Roost Number						Total
	1	17	18	15	19	16	
28 Oct 1986	a	420	0	0	0	0	420
29 Nov	265	+	0	0	0	0	-
1 Dec	125	291	0	0	0	0	416
10 Dec	0	432	0	0	0	0	432
19 Dec	40	+	0	0	0	0	-
29 Dec	0	411	0	0	0	0	411
28 Jan 1987	0	406	0	0	0	0	406
24 Feb	0	0	215	0	0	0	215
27 Mar	0	0	172	0	0	0	172
24 Apr	0	0	151	0	0	0	151
28 May	10	0	0	+	0	0	-
12 Jun	0	0	0	168	0	0	168
29 Jun	0	0	0	317	39	0	356
1 Jul	0	0	0	174	145	0	319
6 Jul	0	0	0	0	+	0	-
24 Jul	0	0	0	0	0	257	257
25 Sep	0	0	0	0	0	259	259
22 Oct	0	159	0	227	0	0	386

a = 130 bats were present at this roost in the early morning but all moved to Roost 17 at 0940 hr following a disturbance caused by unknown reasons.
+ = Bats present at roost but no count made.
- = No total count made.

Table 3. Number of harem females observed with unweaned young at colonies on Guam and Rota from October 1986 to September 1987.

	No. of Females observed	No. of Females without young	No. of Females w/ small young	No. of Females w/ medium young	No. of Females w/ large young	% of Females with young
Guam						
Oct	83	68	15	0	0	18.1
Nov	80	66	13	1	0	17.5
Dec	95	85	9	1	0	10.5
Jan	87	72	13	0	0	14.9
Feb	55	49	6	0	0	10.9
Mar	50	48	2	0	0	4.0
Apr	53	47	6	1	0	13.2
May						No Data
Jun						No Data
Jul	59	43	14	2	0	27.1
Aug	65	56	6	2	1	13.8
Sept	69	61	6	2	0	11.6
Total		596	90	9	1	16.6
Rota						
Apr	117	54	20	27	16	53.8

Table 4. Numbers of frozen fruit bats requested for import to Guam between October 1, 1986 to September 30, 1987.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	No. of Permits Issued
Palau	349	1,333	4,387	905	2,370	4,400	3,920	2,745	3,497	2,950	2,631	1,762	31,249	377
Pohnpei	345	720	100	100	75	230	50	40	450	150	1,785	460	4,505	60
Truk	100	200	150	310	70	400	200	280	800	380	352	345	3,587	39
Western Samoa					600	400		1,000	900			500	3,400	10
Indonesia			300	50	500		300	160	700	300			2,310	13
American Samoa		75	150										225	3
Kosrae					50	50					10		110	3
TOTAL	794	2,328	5,087	1,365	3,665	5,480	4,470	4,225	6,347	3,780	4,778	3,067	45,386	508

Table 5. Numbers of frozen fruit bats imported to Guam from October 1, 1986 to September 30, 1987.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total*	No. of Shipments Received*	No. of Bats Confiscated	No. of Shipments Confiscated
Palau	30	583	724	115	405	1,159	483	501	1,513	541	535	503	7,092	172	329	24
Pohnpei	8		200				50		358	50	307	102	1,075	16	64	3
Truk				150		50		118	120	60	88	60	646	9	118	1
Western Samoa							200			100			300	2	0	0
Philippines									153		18		171	2	171	2
Unknown					7		2			75			84	3	84	3
Yap					5		12						17	2	17	2
Rota	9	1		2			2						14	6	14	6
Saipan					2				1			2	5	3	5	3
TOTAL	47	584	924	267	419	1,209	749	619	2,145	826	948	667	9,404	215	802	44

*Totals include confiscated bats.

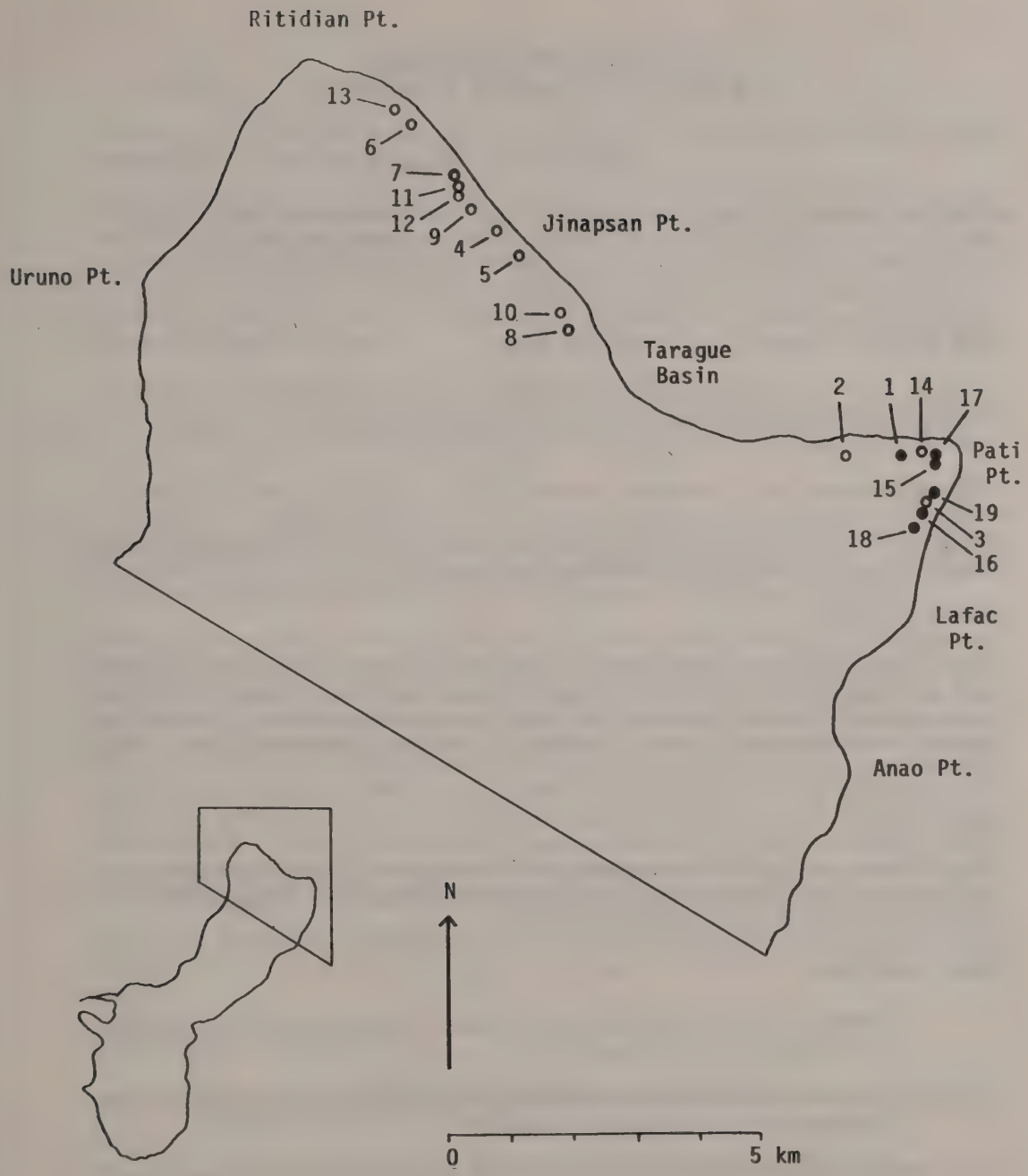

Figure 1. Locations of 19 roost sites used by Marianas fruit bats on Guam from FY1981-FY1987. Numbers correspond to roost numbers listed in Table 1. Closed circles (●) represent roosts used in FY1987 Open circles (o) represent roosts used sometime between FY1981-FY1986. Roosts 1,15,16, and 17 were also used in previous years (Table 1).

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 7
JOB NO.: 1

JOB TITLE: Biology of the Brown Tree Snake

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Studies on the impact of the brown tree snake, *Boiga irregularis*, on Guam's avifauna and on the ecology and biology of this snake are in progress.

BACKGROUND

Guam's native birds have declined drastically in recent decades while avian populations have remained relatively stable on other nearby islands. Research indicates *B. irregularis* is responsible for the range reductions and extinctions of the forest avifauna. Research also suggests that the brown tree snake is a potentially serious predator of Marianas fruit bats on Guam.

OBJECTIVE

To gain the knowledge and understanding of the biology and ecology of the brown tree snake necessary for the development of effective control measures as recommended in the Native Forest Bird and Fruit Bat Recovery Plans.

PROCEDURES

1. Procedures used for determining the impact of *Boiga irregularis* on the native birds are detailed in Savidge (1987).

2. Transects with bird-baited funnel traps were employed to determine predation pressure in various locations on Guam.

3. Nests of the Philippine Turtle-Dove were monitored by P. Conry, DAWR biologist, to determine nesting success and causes of nest failure.

4. Distribution and abundance of alternative prey items for the snake, particularly small mammals, were investigated.

5. Snakes have been collected on a regular basis to track changes in diet as prey populations decline, to document what prey the various size classes take, to gain information on the age structure of the snake population, and to study the reproductive biology of the species.

RESULTS

Research results concerning the impact of *B. irregularis* on Guam's native forest avifauna was published in the journal Ecology (Savidge, 1987).

The Dandan area was trapped using bird-baited traps and higher levels of snake predation were found than in previous trapping efforts. Coincident small mammal trapping revealed that small mammal numbers in the Dandan area were down. Bird-baited snake traps in fields in the Two-Lovers Point area revealed relatively high snake densities, which help to explain why small mammals have declined in this habitat as indicated in concurrent small mammal trapping in the area.

Studies on the nesting success of the introduced Philippine Turtle-Doves (*Streptopelia bitorquata*) indicate continued low nesting success largely due to predation by snakes (Conry, 1987). See FW-2R-24, Sub-Project W-2, Study 1, Job 2, for additional details.

A paper on the impact of *Boiga* on small mammal populations is in preparation (Savidge, In preparation). Additional trapping for small mammals confirmed that their densities are still very low on Guam and that these species have probably also been severely impacted by the brown tree snake. *R. exulans* was found on Cocos Island. This is the only location that this species has been caught at although it was previously common on Guam.

Snakes are being collected on a monthly basis to obtain information on diet, reproduction, and population characteristics. A paper has been written on the food habits of *Boiga* and is currently in press (Savidge, In press). Analyses of 683 snake stomachs showed that *Boiga* is generalized in diet and consumes birds and their eggs, small mammals, and lizards and lizard eggs. Ontogenetic differences in diet were present. Small snakes eat primarily lizards, and large snakes consume birds, bird eggs and small mammals. All three prey types are consumed by medium-sized snakes. The size structure of the snake population reflects the available prey base. There are few birds and small mammals left in forest and second-growth habitat, and consequently, there are also few large snakes in these habitats. Reproductive data is still being analyzed, but it appears that the snakes reproduce year-round though there may be a breeding peak during the wet season.

Progress on this Job was significantly slowed down when Wildlife Biologist Julie Savidge resigned in June, 1987, to accept other employment. Recruitment efforts are currently underway.

RECOMMENDATIONS

1. Recruit a new Wildlife Biologist with specialized experience and training in herpetology as soon as possible.

2. Publish existing data on the impact of *Boiga* on its mammalian prey and on *Boiga's* reproductive biology.

3. Continue to investigate the natural history, abundance and distribution of *Boiga*..

4. Encourage continued Federal involvement in developing control methods for *Boiga*.

LITERATURE CITED

Conry, P. In press. High nest predation by brown tree snakes on Guam. Condor.
Savidge, J. A. 1987. Extinction of an island forest avifauna by an introduced snake. Ecology.

Savidge, J. A. In preparation. The impact of the introduced snake, *Boiga irregularis*, on the small mammals of Guam.

Savidge, J. A. In press. Food habits of *Boiga irregularis*, an introduced predator on Guam. Journal of Herpetology.

Report prepared by: Julie A. Savidge and Robert D. Anderson

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 7
JOB NO.: 2

JOB TITLE: Movements, Home Range and Activity Patterns of the Brown Tree Snake

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

Two brown tree snakes (*Boiga irregularis*) were successfully instrumented with radio transmitters during FY 1987. One individual tracked in northern Guam exhibited extremely restricted movements and used underground hiding locations exclusively during a 25-day period in the dry season. A second snake followed on Naval Magazine at the same time used a 2.8-ha-sized area over 21 days and relied primarily on cavities in rock outcrops and beneath piles of rocks for resting sites.

BACKGROUND

Predation by brown tree snakes is the primary cause for the range reductions and extinctions of 10 species of native forest birds on Guam (Savidge 1987). Snakes are also thought to be a major predator on the island's population of Marianas fruit bats (*Pteropus mariannus*) (Wiles, in press). Recovery efforts for endangered birds and bats on Guam should concentrate on controlling and perhaps eventually eradicating brown tree snakes from the island. Information on the ecology and biology of *B. irregularis* will be useful in designing and implementing a control program for these animals. The use of radio telemetry will assist researchers in learning more about the species' movements, activity patterns and habitat use.

OBJECTIVES

To study the movements and activity patterns of brown tree snakes in order to gain the knowledge and understanding necessary to evaluate predation impacts and to develop effective control methods as recommended in the Native Forest Bird and Fruit Bat Recovery Plans.

PROCEDURES

1. Medium-sized snakes were captured in quail-baited traps and brought to the Guam Division of Aquatic and Wildlife Resources.

2. Snakes were immobilized with ketamine hydrochloride and radio transmitters were implanted into the posterior portion of their abdomens (Wiles 1985).

3. After a one to two-day recovery period, instrumented snakes were released back into the wild at their point of capture. Animals were relocated on an almost daily basis using a hand-held antenna to track transmitter signals.

4. A number of information parameters were recorded at each daytime resting site where asnake was relocated. These included data on behavior, distances moved, habitat characteristics, and weather.

RESULTS

Two methods were used to capture snakes. Live-trapping with mesh snake traps baited with live quail was the only method that was successful at catching snakes that were large enough to be fitted with radio transmitters. Two snakes of suitable size were caught in 80 trap-nights of effort with this technique (Table 1). In contrast, trapping with chicken droppings as bait failed to catch any snakes in 276 nights of effort. Nighttime searching for snakes with flashlights resulted in 13 snakes being caught in 24 hours of effort, however, none of the animals captured were large enough to allow transmitters to be implanted into their abdominal cavities.

Three snakes were captured during FY 1987 and implanted with radio transmitters. One individual, a female weighing 118 gr and measuring 1.34 m in total length, died in captivity three days after its implant operation.

The first successfully released snake was a female that weighed 115 gr and measured 1.31 m in total length. It was captured in secondary forest in the Conventional Weapons Storage Area of Andersen Air Force Base and was located 23 times during a 25-day period of extremely dry weather in March and April. The snake used two underground resting sites during this time, both of which occurred in a large post-war trash dump that was overgrown with trees. The first location was inside a pile of badly rusted tin cans that was about 2 m x 2 m in size and 30 cm deep, and was riddled with numerous small cavities. The snake was dug up after three consecutive days of hiding there and was found sleeping in a tightly coiled position inside a small cavity 15 cm below the surface of the ground. On the following day, the snake was tracked to a similar location that was 28 m away. It remained there until the signal from its radio transmitter was lost 21 days later. During this period, the snake was tracked on three consecutive evenings at 1.5-hr intervals from 1930 hr to about 2300 hr. The snake was active only once during these nine locations. On that occasion, it was observed foraging in a slow methodical searching manner 0.5 m above the ground in a shrub directly over its daytime resting location.

A second snake, a male weighing 238 gr and measuring 1.48 m in total length, was captured opportunistically by hand in a cave in the "12 Group" magazine complex on Naval Magazine. It was located 13 times during a 21-day period in March and April in an area of mixed secondary forest, composed primarily of *Vitex parviflora*, and grassland. During the study period, the snake's movements were confined to a single small hill bordered by mowed grass lawns and a paved road on three sides. A triangular-shaped area that was approximately 2.8 ha in size was used during this time. The average distance moved per day during a 6 consecutive day tracking period was 46.5 m with movements occurring on 5 days during this time. The snake was apparently inactive at the time each radio location was made, which were all obtained during daylight. The snake used a variety of resting sites but was never relocated inside the cave after its release. Seven radio fixes were made along rocks outcrops found in secondary forest, four fixes occurred underground beneath piles of rocks in areas of herbaceous growth or sparse grasses, and two locations were made on the surface of the ground under heavy mats of dead grasses in thick grassland. Trees were not used for resting sites by the snake, probably because *Vitex* is characterized by open, airy

crowns that provide few suitable places for hiding. The snake chose resting sites that were dark and were relatively cooler than outside locations. Air temperatures at resting sites averaged 2.3°C (range=0-3.9°C) cooler than those measured above the canopy.

Preliminary conclusions based on data collected in FY 1986 (Wiles 1986) and FY 1987 indicate that brown tree snakes are capable of using a variety of types of daytime resting locations, including tree tops, cavities in rock outcrops and below the surface of the ground, and under thick mats of grass in grasslands. Some individuals may exhibit greatly restricted activity or movements during the dry season.

RECOMMENDATIONS

1. Conduct this study on a full-time basis in FY 1988 and monitor the movements of at least 8 individual snakes.

2. Increase the amount of night-time tracking to learn more about snake behavior at night. Conduct 24-hour tracking sessions to obtain more accurate information on daily movements.

3. Continue to conduct the study in the CWA of AAFB. This area of secondary limestone forest is representative of large areas of forest found in much of northern Guam. The area appears to contain a high density of snakes.

LITERATURE CITED

Fritts, T.H. and N.J. Scott, Jr. 1985. The brown tree snake on Guam: studies of its ecology, control, and threats to other islands. U.S. Fish and Wildlife Service, Portland. Unpublished. 85 pp.

Savidge, J.A. 1987. Extinction of an island forest avifauna by an introduced snake. Ecology 68:660-668.

Wiles, G.J. 1985. Preliminary results of a radio-tracking study of brown tree snakes on Guam. Guam Div. Aquatic Wildl. Resources Ann. Rept., FY 1985. Dept. Agriculture, Mangilao.

Wiles, G.J. 1986. Movements, home ranges and activity patterns of brown tree snakes. Guam Div. Aquatic Wildl. Resources Ann. Rept., FY 1986. Dept. Agriculture, Mangilao.

Wiles, G.J. in press. Current research and future management of Marianas fruit bats (Chiroptera: Pteropodidae) on Guam. Australian Mammalogy.

Report prepared by: Gary J. Wiles

Table 1. Capture efforts made for brown tree snakes by trapping and nighttime hunting in the Conventional Weapons Area, AAFB, FY 1987.

Date	Method	Bait	No. of Trap Nights	No. of Man-Hours of Searching	No. of Snakes Captured	Notes
7-17 March	trapping	live quail	80		3	2 snakes were large enough to implant transmitters into.
5-12 August	trapping	dried chicken droppings	84		0	
12-28 August	trapping	fresh chicken droppings	192		0	
February-March	nighttime hunting			14	5	All snakes captured were small.
July-August	nighttime hunting			10	8	All snakes captured were small.

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 7
JOB NO.: 3

JOB TITLE: Development and Testing of Control Methods for the Brown Tree Snake

PERIOD COVERED: October 1, 1986 to September 30, 1987

SUMMARY

No significant effort was expended on this job during this segment.

Report prepared by: Robert D. Anderson

JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-2
STUDY NO.: 8
JOB NO.: 1

STUDY TITLE: Public Awareness and Conservation Education

JOB TITLE: Public Awareness and Conservation Education

PERIOD COVERED: October 1, 1986 to September 30, 1987

OBJECTIVES

To inform and educate the public of the need to conserve, restore, and wisely manage the island's endangered species of wildlife as recommended in the Native Forest and Fruit Bat Recovery Plans.

RESULTS

This job was inactive throughout this segment due to funding uncertainties and lack of manpower.

RECOMMENDATION

Activate this job during the next segment provided adequate funding and manpower are available.

Report prepared by Robert D. Anderson

LAW ENFORCEMENT
Funding Source: Government on Guam

LAW ENFORCEMENT

A Total of twenty persons were arrested and charged for the offense of illegal hunting by the Conservation Officers for Fiscal Year 1987. Two of these persons were intercepted by the Military Personnel (Security) and were referred to the Conservation Officers then subsequently charged for violating fish and game laws.

The other eighteen individuals were intercepted by the Conservations Officers during their routine day and night patrol. Five individuals have already pleaded guilty and the rest are awaiting prosecution by the Attorney General.

A total of five vehicles (two Datsun pickup trucks, one Suzuki 4 wheel drive jeep, one Toyota 4x4 pickup truck with camper) that were used to transport game carcasses by some of the individuals charged above and from previous arrest (FY 86) were thereby confiscated as part of the evidence. As a result from these forfeitures all five vehicles had already been legally ordered by the court to be forfeited to the Department of Agriculture for its disposition. A four year old female caraboa that was used in a poaching incident was also confiscated by the Conservation Officers who were attempting to intercept a spotlighting activity in Naval Magazine property. The caraboa, with a load of two deer carcasses, was abandoned by the suspects who evaded apprehension. A forfeiture hearing has been reset and dated to take place on the 16th of October of this year (1987).

In addition as ordered by the court, several weapons and other hunting paraphernalia were also forfeited to the Department for its disposition. Although there were no illegal fishing cases this fiscal year, there were however, illegal fishing incidents reported by concerned citizens. Incidents such as turtle hunting, fish dynamiting, fish weir violations and fish poisoning were investigated by Conservation Officers. By the time the Conservation Officers arrived at the scene to investigate, the responsible persons would no longer be in the area. Several illegal hunting and fishing incidents which were investigated weren't made into cases because of insufficient evidence and warnings were issued.

In April of this year, two previously employed Conservation Officers were reinstated and the Division now has a full complement of eight Officers.